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VARIABILITY IN MAN AND OTHER PRIMATES

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ONE FIGURE

In a recent issue of this journal (vol. 4, p. 402) there have been reprinted some sweeping, entirely unsupported and, if correct, highly significant claims by Montagu ('44) regarding the degrees of primate and of human variability. Essentially the same or at least similar claims have haunted sociological and even philosophical literature for some time, but have so far not succeeded in infecting serious biological thought. largely because they lack any critical proof. The writer, who has been actively interested in problems of comparative variability, finds himself impelled to challenge Montagu's unscientific generalizations, particularly since one of them has been underlined by the confident admonition: "This cannot be too strongly stressed, for its implications are of the greatest importance, while neglect of this fact has been responsible for untold numbers of errors."

The first of Montagu's claims reads: "The principal distinguishing characteristic of the primates is their great variability. Probably no other order of mammals exhibits so great a variability." This more concise than precise statement possibly refers to the diversity of forms, included in the order of primates. It is well-known, however, that such other orders as the marsupials, rodents, or artiodactyls, contain far more widely differing types than the order of primates. Marsupials constitute an extremely diversified group of mammals, including herbivorous, insectivorous and carnivorous forms,

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they vary in size from diminutive pouched mice to very large kangaroos, they have become adapted to terrestrial, arboreal, aquatic, and burrowing modes of life, and they can run, hop, climb, and fly. According to Simpson's ('45) recent review the order of primates comprises only 99 extinct and 59 living genera (total = 158), whereas the order of rodents contains 275 extinct and 344 living genera (total = 619) and the order of artiodactyls 333 extinct and 86 living genera (total = 419). These few facts suffice to show that nature has experimented less lavishly with primates than with the other mammals mentioned here. Incidentally, no taxonomist would or should ever admit that any order has been delimited as such on the basis of variability as its ''principal distinguishing characteristic.''

It can be assumed that Montagu intended to claim that intraspecific variability is greater in primates than in other mammalian orders. This interpretation, however, must be criticised on the ground that only someone grossly unfamiliar with wild mammals would venture such an impossible generalization. The order of primates includes remarkably stable as well as unusually variable species. Every experienced mammalogist could name animals from other orders which exceed in intraspecific variability some monkeys, and this even in regard to only the few characters commonly dealt with in taxonomic investigations. For instance, in regard to the skull and the skin Alaskan brown bears vary far more than all the proboscis monkeys of Borneo or all the night monkeys of one species in Central America. In the writer's laboratory there is a very large series of adult porpoise skulls (*Tursiops truncatus*) from Cape Hatteras which manifests a degree of variability far exceeding that to be found in any equally large series of skulls of guenons or of macaques, and which is not inferior to normal, modern man in regard to the total ranges of cranial variations. Authorities on the Indian elephant have recorded surprisingly wide ranges of individual variations for this species, in comparison to which the ranges of intraspecific variations in many monkeys appear insignificant.

There is no need for further documentation and discussion in refuting this facile, but untenable claim that the entire order of primates is characterized by exceptional variability.

Montagu's second and most daring claim consists in the blunt assertion that "Man is the most variable of all animals." Not even domesticated animals are excepted nor any insects, mollusks or birds! Montagu apparently does not feel that his "conclusion" requires the support of facts or references to responsible authorities, but treats it as something to be expected and as an elementary, logical deduction from circumstances known to everybody, but overlooked by most. He, graciously, reminds the reader that: "In addition to the inherent tendency in the genetic make-up of the organism to vary, man is exposed to a more complex and more variable environment than any other animal. A great part of this complex and variable environment is, of course, of his own making and may collectively be embraced under the term *the socio-economic complex*. This is the totality of social and economic factors which exert their influence on the individual and the group, from birth to death." It is not to be denied that modern man, as the only cosmopolitan primate, can and does exist in an exceptionally varied environment, that environmental factors can influence the human body to a limited extent and that, hence, one might expect that mankind has become morphologically somewhat more varied with the rise in diversity of environmental conditions. Such speculations imply necessarily that man of the past was less variable than is modern man, an assumption which has not been proved thus far, nor does this appear probable from what is known today. Disregarding any expected or unexpected consequences of "socio-economic complexes," the writer is here concerned merely with the direct bearing of known facts upon the basic question whether or not man is more variable than all other animals in regard to bodily characters. With the following notes, therefore, it is intended to recall a small part of all that evidence which is capable of comparing the variability of man with that of other animals and, particularly, other primates. Since most the facts to be mentioned have already been published in detail, they are here given in the briefest possible form and merely as samples of the pertinent information contained in the literature.

At the close of the last century Schwalbe (1898) had already pointed out that cranial variability in modern man does not surpass the variability in size and proportions of the skulls of approximately 200 wild otters from one limited district of Alsace. Based upon extensive material of spider monkeys and of howler monkeys from a small area of jungle the writer ('26a and b) has demonstrated that, at least in regard to the skull, spider monkeys are not only more variable than howler monkeys, but also more variable than some human series. For instance, the averages of the variation coefficients for numerous cranial measurements and indices equal 3.1 in howler monkeys, 3.5 in a series of Swiss Alpines, and 4.4 in spider monkeys. In later papers the writer ('41, '44) recorded in detail the conditions of variability in orang-utans and in gibbons and again showed that, regarding cranial variability, wild simian primates of one species can equal or even surpass many human groups. The cranial length-breadth index, e.g., was found to range between 69 and 93 in 105 adult wild orang-utans, or approximately as much as in normal, adult human beings, including different races and far larger series. How widely cranial variability can differ among non-human primates could be readily demonstrated by quoting numerous taxonomic publications. Strikingly high degrees of this variability have been recorded, e.g., for some primates of the Congo by Allen ('25) and for orang-utans by Selenka (1898). The accompanying figure, copied from another paper (now in press) by the writer, must suffice here as evidence for the statement that *Gorilla gorilla* can vary as extensively as *Homo sapiens* in general formation of the skull. The same conclusion could have been drawn from such detailed reports on gorillas as those by Coolidge ('29) and by Randall ('43–'44).

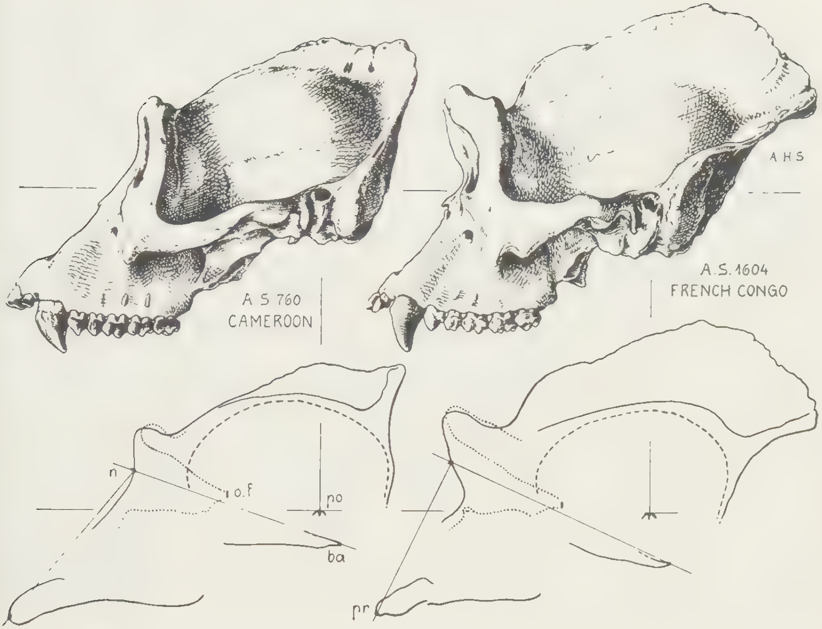

Fig. 1 Variations in the skulls of wild, adult, male lowland gorillas. Side-views above and mid-sagittal sections with superimposed mid-orbital sections below. From a paper (now in press) by the author.

TABLE 1

The absolute and relative ranges of variations in the cranial capacities (cm³) of adult higher primates, according to data from the literature and the author's own records.

PRIMATE	SEX	SPECIMENS	AVERAGE	RANGE OF VARIATIONS	RANGE IN % OF AVERAGE
HYLOBATES LAR					
(Chiengmai)	♀	85	100.9	82–116	33.7
Schultz, '44	♂	95	104.0	89–125	34.6
ORANG-UTAN	♀	111	365.6	276–494	59.6
Schultz, '41	♂	96	423.6	300–540	56.7
CHIMPANZEE	♀	45	354.1	290–455	46.6
Schultz, '40	♂	49	392.7	322–500	45.3
GORILLA	♀	173	458.0	340–595	55.7
Schultz (in press)	♂	301	531.7	420–685	49.8
MAN	♀	(many	1350	1050–1650	44.4
(approximately, no		different			
rare extremes)	♂	series)	1450	1100–1800	48.3

The data in table 1 indicate clearly that the relative range of individual variations in the cranial capacity of adults is not exceptionally marked in man, but actually inferior to that in orang-utan. For instance, in a series of 1179 adult white males (Cleveland population) the cranial capacity varies, according to Simmons ('42), between 1099 and 1782 cm^3. This range amounts to 47% of the mean value of all variations, i.e., to less than in orang-utans or in gorillas.

According to Ashley-Montagu's ('33) own report, the sutures in the pterion region are arranged in one and the same manner in 87.8% of 2237 human skulls, including many different races, but in only 67.7% of 146 orang-utan skulls. In this feature, therefore, man is more stable than the ape. The relative size and shape of the nasal bones and the ages of obliteration of the internasal suture are far more variable in gibbons and in orang-utans than in man (Selenka, 1898, Schultz, '41, '44). On the other hand, it should also be pointed out here that in many species of monkeys such cranial characters as the length-breadth index, the capacity, the pterion formation, the nasal bones, etc., are a great deal more constant than in the anthropoid apes or, for that matter, than in some species of mammals other than primates.

A glance at the pictures showing some of the amazing variations in the formation of the adult sternum in gibbons, orang-utans and chimpanzees, contained in other papers by the author ('40, fig. 10; '41, fig. 12; '44, fig. 17), will induce any anatomist to admit that no such variability has ever been found in adult human sterna. The number of ribs attached to the sternum also is more constant in man than in the apes and in 2 of the 3 monkey species for which reliable information has become available. This is shown by the data in table 2. It must be mentioned here that, according to Randall ('43–'44), gorilla is no more variable in this respect than man, inasmuch as he found 7 pairs of sternal ribs in 92% of gorillas. This percentage would drop to 87 if the series of Randall is combined with that of the writer. In a recent paper by Schultz and Straus ('45) on numerical variations in vertebrae it was shown that the statistical norm for the numbers of cervical, thoracic, lumbar, and sacral vertebrae exists in 62.5% of human beings,[1] each of all other combinations of numerical variations in these vertebrae being limited to smaller percentages. The statistical norms for the precaudal vertebrae in other primates have been found with the following percentage frequencies: *Oedipomidas geoffroyi* = 59.6, *Nasalis larvatus* = 85.7, langurs (including different species) = 88.8, gibbons = 36.5 (*Hylobates lar* alone = 38.7), orang-utan = 40.0, chimpanzee = 29.3, and gorilla = 28.1. There cannot be the slightest doubt that in regard to the regional differentiation of the vertebral column all mankind is quite stable, whereas every one of the man-like apes is amazingly variable. Even this enormous vertebral variability of the anthropoid apes is surpassed in the prosimian species *Perodicticus potto* in which every one of eight specimens examined had an individually differing vertebral formula.

TABLE 2

The number of pairs of sternal ribs in different primates, according to the author's records.

PRIMATE	SPECIMENS	AVERAGE NUMBER	PERCENTAGE OF CASES WITH 6 or 6½	7 pairs	7½ or 8
Macaca mulatta	45	7.8	0	18	82
Cercopithecus callitrichus	17	7.6	0	41	59
Nasalis larvatus	41	7.0	0	100	0
Hylobates lar	233	7.1	11	72	17
Orang-utan	89	6.7	42	53	5
Chimpanzee	63	7.0	14	76	10
Gorilla	14	6.5	50	50	0
Man (several races)	124	7.0	4	90	6

Regarding the variability of body proportions in different primates the following remarks must suffice here: The range of individual variations in the skeletal intermembral index of adults extends over 14.7 index units in man (753 cases, including 6 racial groups), also over 14.7 units in lowland gorillas (153 cases), and over 15.9 units in orang-utans (79 cases) (Schultz, '37). Based upon the same material the writer obtained mean variation coefficients for the most important dimensions and proportions of adult limb bones which amount to 3.96 in man, 3.72 in gorilla and 4.16 in orang-utan. The proportions of the outer body in the adult wild gibbons from one small district in Siam, described elsewhere by the author ('44), vary in general as much as the corresponding proportions in most human series. According to the writer's extensive and as yet mostly unpublished data for the body proportions in lower primates these proportions can differ widely in intensity of variability among different species. In some monkeys the body proportions are clearly more constant than in man, but in some others they can differ individually to a surprising degree, ranging between extremes at least as far apart as in most series of normal human beings.

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[1] This percentage is usually even higher, according to reports on other and larger human series.

In general body size and weight man normally does not seem to vary more than many species of wild simian primates, if due allowance is made for the tremendous discrepancy in the numbers of records available for the former and the latter. For instance, the body weight of 17 fully adult, healthy, female Rhesus monkeys varies between 4.37 and 10.37 kg (Schultz, '33). This range of individual variations, in percentage of the average weight for the series, equals 96. As far as known to the author, the literature contains only 5 reliable records for body weights of adult, male, wild-shot mountain gorillas and these give values extending from 132.9 to 208.7 kg (Akeley, '23, Gyldenstolpe, '28, Gregory and Raven, '37). This range amounts to 46% of the average for the small series.[2] Data for other simian primates have been collected in table 3. In some of these, unfortunately still very small, series the ranges of variations equal or surpass half the corresponding average values. Such variability in normal, healthy animals which had lived under ideally uniform environmental conditions, all eating the same food and performing the same exercise, may be surprising to those who expect to find in human variations the profound effects of diverse socio-economic complexes. To obtain relative ranges of variations in body weight equal to some of those given here for very modest series of wild simian primates, would generally require far larger random sample-series of weight records for normal, adult man.

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[2] This percentage would increase greatly, if one included here the few reliable data for body weight in captive, adult, male gorillas which vary between 267 and 287 kg.

TABLE 3

The absolute and relative ranges of variations in the body weights (kg) of adult primates, according to the author's reords. All are wild-shot specimens from extremely limited areas of jungle, except for some of the orang-utans.

PRIMATE	SEX	SPECIMENS	AVERAGE	RANGE OF VARIATIONS	RANGE IN % OF AVERAGE
Ateles geoffroyi	♀	35	8.01	5.90–11.00	64
(Panama)	♂	22	7.36	6.01– 8.62	36
Macaca irus	♀	8	2.98	2.49– 3.40	31
(N. Borneo)	♂	13	4.66	3.63– 5.90	49
Semnopithecus cristatus	♀	24	5.74	4.99– 6.58	28
(N. Borneo)	♂	14	6.46	4.99– 7.94	37
Semnopithecus rubicundus	♀	13	5.74	4.54– 7.03	43
(N. Borneo)	♂	14	6.19	5.44– 7.03	26
Nasalis larvatus	♀	15	9.87	8.16–11.79	37
(N. Borneo)	♂	10	20.34	14.06–23.59	47
Hylobates lar	♀	37	5.30	3.86– 6.12	43
(N. Siam)	♂	43	5.71	4.08– 7.26	56
Orang-utan	♀	8	36.85	27.22–45.36	49
	♂	13	74.89	58.29–90.72	43

Simpson ('44), after referring to the many coefficients of variation for human morphological characters (including body weight) compiled by Pearl ('40), concludes that all these coefficients "demonstrate quite usual variability for a mammal, similar to that in single races of horses, cats, and many other groups of about average evolutionary rates within the Mammalia.''

The detailed report on dermatoglyphics in primates by Midlo and Cummins ('42) leaves little doubt that these structures are as variable in at least the great apes as in man, particularly if it is remembered that for dermatoglyphics, as for all other features, infinitely more data have been recorded for man than for any non-human primates. From the writer's current investigation on the palatine ridges in primates the following few facts may here be mentioned: The number of palatine ridges on one side varies between 7 and 9 in 12 *Cercopithecus callitrichus,* between 2 and 8 [3] in 589 human beings, and between 5 and 15 in 23 chimpanzees. Records on 589, instead of only 23, chimpanzees would most likely have increased the range of individual variations, but even now it can be stated that in regard to the ridges on the palate man is less variable than chimpanzee.

The wide range of human variations in skin color becomes much less impressive when it is recalled that among chimpanzees, e.g., the color of the skin can vary from nearly white to brown to practically black, and this often with regional limits or else with the inclusion of the entire body surface and even the palms and soles. Yerkes ('43) speaks of skin color in chimpanzees as ranging ''from Caucasian white to Negro black.''

The coloration of the hair can vary intraspecifically far more in some simian primates than in man, as is evident from numerous, detailed taxonomic reports. For instance, Allen ('25) has discussed the wide range of hair coloration in adult, wild chimpanzees from one limited district. Yerkes ('43) states that coat color in chimpanzees varies ''from jet black to faded brown or dirty gray.'' In regard to gibbons Elliot ('13) comments as follows: ''Uniformity of coloring is not one of the tenets of the species *Hylobates,* and so far as the hues of their coats are concerned each one wears whatever seems best in his own eyes. The quantity and depth of color pigments among the members of the different species is a most uncertain quality, and rarely do two individuals possess them in the same degree, otherwise these many and extreme variations are quite unaccountable.'' Based upon his field notes from 2 collecting trips to Eastern Nicaragua, the writer can here insert the following pertinent observations: No noteworthy individual variations in the characters of the hair were encountered among numerous *Cebus capucinus.* Occasional marked deviations from an average coloration of hair were found in the great many *Alouatta palliata* which had been shot on these trips. In *Ateles geoffroyi*, however, the hair varied in color and, particularly, in distribution of color to such an extent that the precise records for no 2 specimens are alike, even though they often appertain to individuals which had belonged to one and the same local group.

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[3] In this series for man 8 ridges exist in only one case and 2 ridges in only two cases.

According to our present knowledge it appears that eye color is more variable in man than in other primates. This distinction, if correct, is probably due chiefly to the absence of pigment in the anterior layers of the iris in human beings with light-colored eyes. In the great apes the iris can vary individually, as far as known, between fairly light brown and nearly black. Yellow-brown, hazel and even ''partly blue'' eye colors, in addition to medium brown and very dark brown colors, have been recorded for some few monkeys, but without reference to the age of the animals which has an important bearing on such data in monkeys, just as in man. Exact information on eye color in monkeys and apes is still far too scanty to permit any valid conclusions regarding the intraspecific (or intrageneric) variability of this feature.

Where is there anything among all known human variations that can compare with the puzzling, enormous individual differences in the grotesque cheek pads of orang-utans? These structures can be huge in some males, totally lacking in others from the same region, and be present in an occasional female. These pads are clearly indicated in all older fetuses and infants, disappear in juvenile life, only to re-appear among mature animals in a highly variable manner and without strict correlation with distribution or race. None of the many morphological differences which have been found between such widely separated human groups as Australians and Eskimos, is greater or more deep-seated than differences known to occur among orang-utans. The latter may differ less than the former in skin color or in the relative length of their limbs, but they can vary much more in certain facial and laryngeal structures, in the formation of the sternum, of the great toe, and of the musculature of hand and foot, in the numbers of vertebrae in most spinal regions, etc.

In contrasting the variability of man with that in each of the 3 great apes one is exposed to the objection that the single species of man should not be compared with entire genera of apes, since the latter are often held to contain 2 or more species in each. This compels the writer to insert a confession which he cannot amplify here. The more he has learned of the recent great apes the more he realizes that their intrageneric differences are no more profound and significant than the well-known differences between some human groups. The writer has reached the conviction that, if, e.g., Hottentots and Tasmanians are different races, then lowland- and mountain gorillas, Bornean and Sumatran orang-utans, and West- and Central-African chimpanzees are also only different races and, if these apes are regarded as different species, then we should recognize different species in modern man, regardless of how many intergradations exist. The most satisfactory solution consists, most likely, in a uniformly applied subspecific division for man and for the single species within each of the genera of great apes. As is well-known, such classifications for mankind and for the apes are not new in the literature and it is to be hoped that they will become generally accepted and perfected.

The mass of publications on primates, representing widely different types of investigation, could supply many additional data suitable as a scale for the evaluation of human variability. So far most anatomical studies on non-human primates have been concerned chiefly with intergeneric, phylogenetic trends, rather than with intraspecific variations. Much remains to be done before really representative ranges of individual variations will become known for anatomical characters of the primates besides man. However, the information available so far, even though only fragmentary, is ample for an emphatic denial of the claim that man is the most variable of all animals or, indeed, of the primates alone. In fact in some significant respects mankind of today is endowed with greater stability than certain other primates, existing under extremely uniform environmental conditions in contrast to man. To quote Montagu once more: ''This cannot be too strongly stressed, for its implications are of the greatest importance . . .''

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FACTORIAL ANALYSIS OF BODY MEASUREMENTS[1]

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THREE FIGURES

INTRODUCTION

Since the application of multiple factor analysis in the study of body measurements is rather new, it seems appropriate to make a brief statement about multiple factor analysis as a scientific method.

If a set of n measurements is taken on each one of N individuals, and if these measurements are generally correlated, then it is sometimes an interesting and important problem to ascertain whether the n measurements can be expressed as linear combinations of a smaller number of basic parameters or factors. Factor analysis usually starts with a table of correlations between all the variables. The factorial problem is usually restricted to the problem of ascertaining whether the intercorrelations can be accounted for by a limited number of basic measures or factors. It can be shown that this number of factors is the rank of the table of correlations considered as a determinant.

When the number of basic factors is as small as 2, then the saturation of each of these factors in each of the variables can be shown in a flat two-dimensional diagram. Each variable is then a point on such a diagram which may also be interpreted as the terminus of a vector in two dimensions. When the number of basic factors is 3, then the diagram becomes extended to a three-dimensional model. When the number of common factors is more than 3, it becomes necessary to deal with the geometrical interpretation in analytical form because models cannot be constructed in more than three dimensions. The number of dimensions of the model, or geometric representation, is the same as the number of factors that are common to the variables.

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In factor analysis we distinguish between those factors which are shared by two or more of the measures, and those factors which are unique for each variable. The experimental errors are in the latter class, as well as those factors which do not occur in more than one of the measures. In the present analysis we have limited ourselves to those factors which are shared by two or more of the measures. Such factors are called ''common factors'' to distinguish them from what are called ''unique factors.'' That part of the variance of each measure which it shares with other measures in the same study is called the communality of the measure. The saturation of a factor in one of the measures is that part of the variance of the measure which is attributable to the factor in question.

There are different methods of reducing the correlations to factors and, in general, the choice of factoring method is a matter of preference for different computing routines. The centroid factors are those which have been determined by any one of several factoring methods that are called centroid methods.

The rotational problem in factor analysis can be explained in terms of a three-dimensional example. Suppose that a set of correlations is found to contain three common factors. Then the measures can be represented in a three-dimensional model which is determined by the correlations. Two measures that have zero correlation will be separated by a right angle. Negative correlations are represented by obtuse angular separation between the vectors that correspond to the variables. The correlations determine the model but they do not define any reference frame. The choice of reference frame is one of the central problems in factor analysis. Each of the three reference axes that are chosen for the final description of the measures should then be interpreted. For example, if limb length is sustained as one of the basic factors determining body measurements, it is represented in the model by one of the axes. The axes so selected need not be orthogonal to each other. If height and weight eventually be chosen as such axes, then these should be separated by an agle of 60 degrees because the correlation between height and weight is about + .50 in adult males and this is also the cosine of an angle of 60 degrees.

When a set of correlations is reduced to a limited number of factors, it is not to be expected that the small number of factors will exactly account for all the correlations. This is due partly to experimental errors which are not covered by the common factors. The residual correlations show how closely the factors account for the correlations.

Multiple factor analysis is a powerful scientific exploratory method which finds its best applications in new domains where it is desired to locate the most important factors that determine an observed set of correlations. When the most important factors become discernible, one naturally turns to more direct experimental methods of studying each factor whose general nature is then known.

ANALYSIS OF BODY MEASUREMENTS

In a recent paper (Thurstone, '46) we reported a re-analysis of a small set of twelve body measurements that was made by W. H. Hammond ('42). This represented our first application of the multiple factor methods to measurements of this kind. It showed a very clear simple structure which indicated the existence of four primary factors in this domain with plausible interpretation. In this paper we shall report a similar analysis of a somewhat larger set of seventeen body measurements that was reported recently by W. Linford Rees and H. J. Eysenck ('45). The present study supports the previous analysis and indicates the probable fruitfulness of the factorial study of body measurements.

The study by Rees and Eysenck had for its principal problem the relation of body type to temperamental characteristics. In the present study we limit ourselves to the problem of determining dimensionality of the seventeen body measurements as such. The old problem of relating body type and temperament can be studied in two stages. First we have the problem of ascertaining the dimensionality that is actually represented by any particular set of body measurements. This is the problem of determining how many linearly independent parameters or factors are required to describe an entire set of body measurements. When that question has been answered the next logical step would seem to be to inquire whether one or more of the dimensions is functionally related to temperamental characteristics. Some of these factors that determine body proportions might be found to be related to temperamental characteristics, whereas other body measurements might be found unrelated to temperament.

The brief factorial analysis reported by Rees and Eysenck was carried to only two factors. When we repeated this analysis we found rather large residuals so that our analysis was carried to seven factors. Rees and Eysenck reported the first two centroid factors which they left without rotation, whereas in the present analysis we made a rotational analysis that revealed an interesting simple structure.

In table 1 we have the correlation matrix as reported by Rees and Eysenck. In this table are also listed the eighteen measurements which included age and weight. Since all of the correlations between age and body measurements were quite low, we eliminated the age variable so that our analysis was limited to the remaining seventeen variables. The orthogonal centroid factor matrix is shown in table 2 for seven factors. The seventh factor correlational residuals are shown in table 7. The root mean square deviation of these residuals is .05 and all but a very small number of them are less than .10. Four out of the 136 residuals exceed .20.

TABLE 1

Correlation matrix R

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Age	. .	—.07	—.05	—.07	.05	.03	—.15	.04	.18	—.10	.00	.16	—.09	—.03	.09	.13	.10	—.01
2. Stature	—.07	. .	.92	.88	.09	.18	.45	.21	.30	.49	.46	.25	.73	.71	.25	.18	.29	.47
3. Suprasternal height	—.05	.92	. .	.85	.11	.19	.49	.24	.35	.50	.50	.33	.80	.78	.32	.26	.38	.55
4. Symphysis height	—.07	.88	.85	. .	.11	.18	.46	.17	.30	.48	.16	.19	.80	.75	.23	.20	.32	.44
5. Skull breadth	.05	.09	.11	.11	. .	.15	.22	.26	.15	.28	.08	.10	.06	.09	.31	.30	.33	.31
6. Skull length	.03	.18	.19	.18	.15	. .	.15	.17	.10	.11	.14	—.05	.20	.22	.17	.15	.10	.27
7. Biacromial diameter	—.15	.45	.49	.46	.22	.15	.	.66	.30	.45	.22	.23	.50	.50	.50	.50	.49	.61
8. Transverse chest diameter	.04	.21	.24	.17	.26	.17	.66	. .	.36	.45	.20	.25	.26	.25	.73	.71	.57	.69
9. Sagittal chest diameter	.18	.30	.35	.30	.15	.10	.30	.36	.	.40	.23	.30	.38	.33	.62	.59	.56	.60
10. Bicristal diameter	—.10	.49	.50	.48	.28	.11	.45	.45	.40	. .	.31	.40	.50	.49	.47	.49	.74	.63
11. Trunk length	.00	.46	.50	.16	.08	.14	.22	.20	.23	.31	. .	.31	.27	.25	.20	.18	.05	.34
12. Sternal length	.16	.25	.33	.19	.10	—.05	.23	.25	.30	.40	.31	. .	.30	.32	.25	.21	.17	.16
13. Arm length to radial styloid	—.09	.73	.80	.80	.06	.20	.50	.26	.38	.50	.27	.30	. .	.27	.08	.14	.14	.10
14. Arm length to tip of medius	—.03	.71	.78	.75	.09	.22	.50	.25	.33	.49	.25	.32	.27	. .	.09	.12	.14	.11
15. Chest circumference at inspiration	.09	.25	.32	.23	.31	.17	.50	.73	.62	.47	.20	.25	.08	.09	.	.32	.22	.22
16. Chest circumference at expiration	.13	.18	.26	.20	.30	.15	.50	.71	.59	.49	.18	.21	.14	.12	.32	. .	.29	.30
17. Hip circumference	.10	.29	.38	.32	.33	.10	.49	.57	.56	.74	.05	.17	.14	.14	.22	.29	. .	.22
18. Weight	—.01	.47	.55	.44	.31	.27	.61	.69	.60	.63	.34	.16	.10	.11	.22	.30	.22	. .

Before proceeding with the rotational problem one can obtain some information about the measures and the domain by inspection of the communalities. It is of interest that five out of these seventeen body measurements have communalities above .90. We take this to be indicative of a relatively low dimensionality of the domain of body measurements when compared with the dimensionality of psychological test performances where the communalities are seldom as high as .90 for small test batteries. Exceptions are those batteries which are assembled from tests with known factorial composition. High communalities in small batteries are the exception in exploratory studies. Another interesting fact is that two of the variables show exceptionally low communalities, namely skull breadth (5) and skull length (6), which have communalities of .17 and .15 respectively. These two low communalities represent the only head measurements in this battery. This fact enables us to conclude with some confidence that there are two

TABLE 2

Orthogonal factor matrix F_o.

	I	II	III	IV	V	VI	VII	h^2
2.	.77	—.55	.11	—.07	—.04	—.05	.02	.92
3.	.83	—.51	.06	—.05	—.07	.05	.08	.97
4.	.72	—.47	.20	.09	—.12	—.20	—.06	.85
5.	.31	.23	.04	—.03	.04	—.05	.12	.17
6.	.25	—.02	.13	—.16	.19	—.10	.05	.15
7.	.73	.14	.17	.20	.23	.09	—.04	.68
8.	.70	.54	.05	.12	.36	.20	—.07	.97
9.	.66	.28	—.38	—.18	—.25	—.25	—.24	.87
10.	.80	.16	—.16	.26	—.31	.09	.38	1.01
11.	.42	—.20	—.19	—.30	.06	.23	.17	.43
12.	.40	—.05	—.36	.13	—.05	.28	.02	.39
13.	.63	—.48	—.15	.19	.14	—.26	.12	.79
14.	.61	—.46	.24	.14	—.17	.18	—.38	.87
15.	.55	.36	—.12	—.21	.20	.10	—.27	.61
16.	.55	.40	—.12	.06	.19	—.11	—.13	.55
17.	.56	.36	.17	.20	—.29	—.19	.12	.65
18.	.68	.26	.34	—.48	—.15	.15	.12	.94

or more factors which determine skull proportions which are relatively independent of the factors that determine the other body measurements of this battery. The fact that the correlation between variables 5 and 6 is so low as .15 in table 1 indicates that these two measures are largely determined by different factors, hence there must be at least two factors primarily concerned with skull dimensions and which are relatively independent of the other body measurements in the present list.

This inference about the factors concerned with head size is related to our previous analysis of Hammond's data. He reported three head measurements, namely, head length, head breadth, and head size with intercorrelations of about .30. In the rotational analysis these three measures revealed at least one primary factor, which we tentatively called head size. Further study with a larger number of skull measurements will probably reveal several factors concerned with head size.

The rotational analysis gave the oblique factor matrix shown in table 4. None of the seven factors in the oblique matrix seems to be residual in character. The rotational solution was guided by the principle that a hyperplane should be located by structure without any attempt to impose a positive manifold. In figures 1A, 1B, and 1C we have represented the plots of all pairs of columns from table 4. It can be seen at once by inspection that this structure is a positive manifold with the exception of the hyperplane G, where one variable shows a negative saturation of — .34. All of the other negative projections are small. The transformation from table 2 to table 4 is shown in the transformation matrix Λ of table 3.

For inspectional purposes it is useful to represent the factor pattern as in table 6, where each of the vanishingly small entries in table 4 is left as a blank cell. The large cell entries in the matrix V are represented by x's in the corresponding cells of the factor pattern.

The interpretation of the factor pattern is the most challenging and interesting part of a factorial study. In our interpretation of the successive factors we shall take them in order.

TABLE 3

Transformation matrix Λ.

	A	B	C	D	E	F	G
I	.27	.38	.17	.20	.23	.14	—.02
II	.30	—.66	—.15	—.07	.34	.17	.02
III	.07	.37	—.62	.24	.06	—.53	.26
IV	.20	.29	.12	—.82	.00	—.37	.07
V	.88	.16	—.16	.05	—.83	—.17	—.44
VI	.06	—.24	.58	.24	—.20	—.33	.61
VII	—.14	—.33	.43	.41	.32	—.62	—.60

$C = \Lambda'\Lambda$.

	A	B	C	D	E	F	G
A	1.01	.17	—.18	—.11	—.62	—.10	—.23
B	.17	.99	—.34	—.21	—.31	—.11	.08
C	—.18	—.34	1.00	.10	.11	—.15	.01
D	—.11	—.21	.10	1.00	.08	—.15	—.12
E	—.62	—.31	.11	.08	1.00	.07	.07
F	—.10	—.11	—.15	—.15	.07	.99	.08
G	—.23	.08	.01	—.12	.07	.08	1.00

TABLE 4

Oblique factor matrix V.

	A	B	C	D	E	F	G
2.	.00	.68	.12	.27	.05	—.01	—.03
3.	.00	.61	.25	.30	.09	—.04	.00
4.	—.04	.73	—.04	.07	.14	.01	.00
5.	.16	—.05	.01	.12	.17	.01	—.11
6.	.19	.15	—.12	.22	—.06	—.01	—.16
7.	.50	.33	.02	.03	.00	—.08	.02
8.	.72	.00	.05	.05	—.01	.04	.02
9.	.00	—.03	.08	.00	.40	.68	—.02
10.	—.02	.02	.51	.08	.59	—.08	—.07
11.	.02	.03	.38	.43	—.02	.05	—.07
12.	.06	.01	.49	—.04	.05	.09	.09
13.	.14	.60	.17	—.04	—.05	.00	—.34
14.	—.01	.73	.01	—.02	—.02	.03	.46
15.	.43	—.04	.00	.15	—.03	.38	.09
16.	.45	.02	—.04	—.07	.08	.27	—.10
17.	.03	.06	—.05	—.05	.58	.01	—.01
18.	.05	—.03	—.03	.67	.40	.04	.13

The first column of the factor pattern shows high saturations in variables 7, 8, 15, 16. The highest saturation is in variable 8. This factor seems to be chest width and might be associated with vital capacity or thoracic volume.

The high saturations in factor B are the measurements 2, 3, 4, 13, 14, and lower saturation on 7. The interpretation of this factor gives a good illustration of a principle in factorial analysis. Our task is to find that which is common to the variables 2, 3, 4 and which is entirely absent in variable 11, namely, trunk length. Trunk length is a part of the measurements 2 and 3 and yet variable 11 has no saturation on factor B. That part of the variance of 2, 3, and 4 which is absent in 11 is evidently leg length. The variance of leg length enters into the total variances of 2, 3, and 4. The other two high saturations are variables 13 and 14, which would naturally be described as arm length. The factor B has high saturations in both leg length and arm length and hence we infer that factor B is concerned with length of extremities. If we note the two highest saturations on factor B, namely, .73 on both 4 and 14, we find that these are in fact direct leg length and arm length measurements. The saturations indicate that over half the variance in the length of extremities is attributable to this factor B. Referring to our previous analysis of Hammond's data, it is interesting to find indication there also about the size of extremities as a separate factor, although this factor was not so clearly indicated as in the data of Rees and Eysenck. There seems to be good justification here for denoting the factor B as limb length. The rather clear isolation of a primary factor of limb length in the present study is supported by the previous factor which we tentatively named bone length for the Hammond data.

The factor C has fairly high saturations in the measures 10, 11, 12. The nature of this factor is not so clearly indicated but it seems to be associated with trunk size. The close association between trunk length and bi cristal diameter as distinguished from the hip circumference should be noted and compared with factorial studies of larger sets of body measurements for clearer interpretation. When factorial studies have been made on larger batteries of measurements the interpretation of the primary factors might eventually be made in embryological terms.

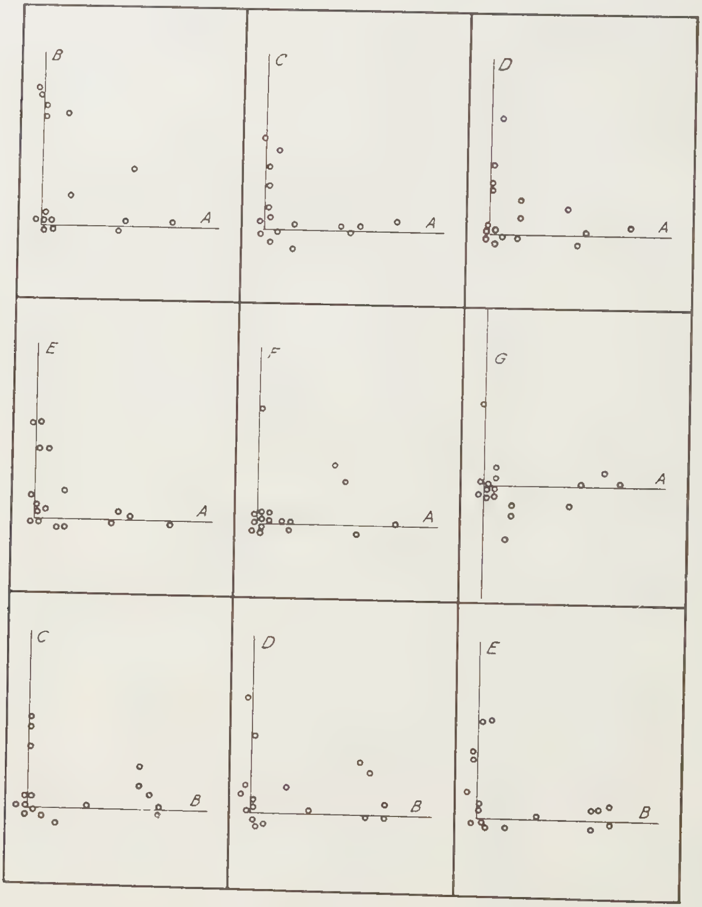

Figure 1 A

The factor D has only one large saturation, namely weight (18). It has several smaller saturations, namely 2, 3, 11. Our tentative interpretation for this factor is that it is associated with size.

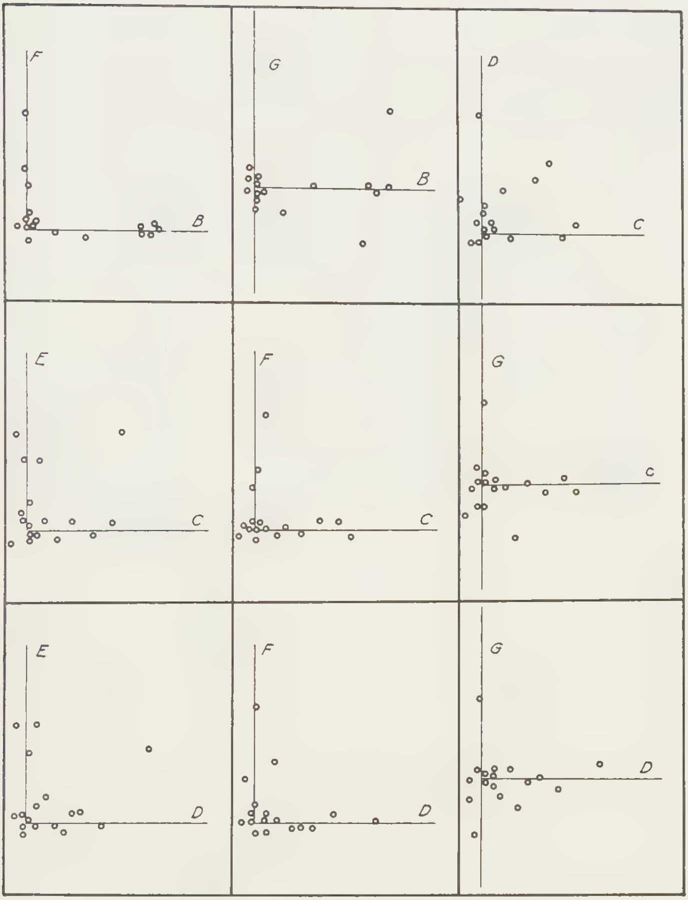

Figure 1 B

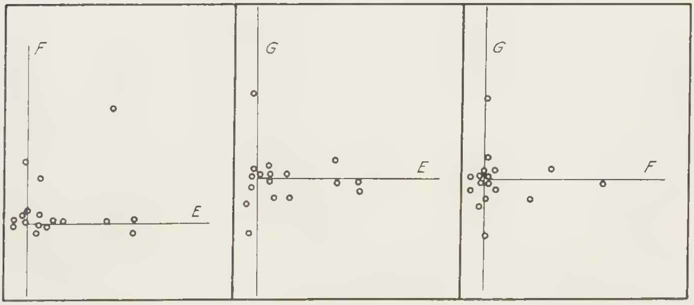

Figure 1 C

The factor E has no very large saturations, but some of them are appreciable for measures 9, 10, 17, 18. These are all girth measurements but it is not clear why 9 has an appreciable saturation of .40, whereas the measure 8 has no saturation on the factor E.

The factor F has high saturation on 9 and appreciable saturations on 15 and 16, with no saturation on any of the other measures. This finding points rather clearly to a factor for chest depth as distinguished from the factor A, which we associated with chest width.

From the standpoint of factorial interpretation the factor G has some special interest. It is essentially a doublet for measures 13 and 14, since these are the only measures which have appreciable saturation on factor G. As is well known in multiple factor analysis, a doublet is always regarded as essentially indeterminate. The hyperplane G was located by density of the points as shown in the several plots of figure 1. When that was done, the two measures 13 and 14 appeared insistently with opposite sign. This was unexpected in the present study because all of the previous factors turned out to be positive simple structure. This doublet factor G seemed to be bi-polar. Inspection of the two measures 13 and 14 indicates an interesting explanation. If measure 14 is arm length, including the length of the hand, then measure 13 can be regarded as arm length minus the length of the hand. These two variables might be thought of vectorially as vector L for total arm length (14) and vector A for arm length measured to the wrist (13). The length of the hand might then be thought of as another vector H, which could be represented vectorially as the vector difference L – A. Our interpretation is that factor G may represent hand length variance. It therefore contributes positively to the total variance of measure 14 but negativity on the variance of 13. This is our interpretation of this interesting structure, namely that the factor G represents hand length. When further factorial studies are made, including measures of hand length and perhaps measures of the feet, it will be interesting to determine whether a primary factor exists controlling size of hands and feet, coordinate with the factor B that controls total limb length. Such a question can be answered in terms of simple structure analysis of larger sets of measurements.

TABLE 5

Correlations between primary factors.

$R_{pq} = D(\Lambda'\Lambda)^{-1} D$

	T_A	T_B	T_C	T_D	T_E	T_F	T_G
T_A	1.00	.09	.19	.13	.60	.12	.23
T_B	.09	1.00	.35	.20	.28	.19	—.09
T_C	.19	.35	1.00	.03	.10	.23	.01
T_D	.13	.20	.03	1.00	.06	.19	.12
T_E	.60	.28	.10	.06	1.00	.05	.08
T_F	.12	.19	.23	.19	.05	1.00	—.04
T_G	.23	—.09	.01	.12	.08	—.04	1.00

TABLE 6

Factor pattern.

	A	B	C	D	E	F	G
2.		x		(x)			
3.		x		(x)			
4.		x					
5.							
6.							
7.	x	(x)					
8.	x						
9.					x	x	
10.			x		x		
11.			x	x			
12.			x				
13.		x					—x
14.		x					x
15.	x					x	
16.	x					(x)	
17.					x		
18.				x	x		

TABLE 7

Seventh factor correlational residuals.

CLASS INTERVAL	FREQUENCY
.26 – .27	1
.24 – .25	. .
.22 – .23	1
.20 – .21	2
.18 – .19	1
.16 – .17	
.14 – .15	5
.12 – .13	2
.10 – .11	7
.08 – .09	15
.06 – .07	16
.04 – .05	28
.02 – .03	32
.00 – .01	26

N = 136.

Root mean square deviation = .05.

The obliqueness of the reference vectors is indicated by the cosines of their angular separations. These are listed in the matrix C of table 3, which shows only one large cosine, namely, — .62 for the reference vectors A and E. From this fact one infers that the correlation between the corresponding primary factors should have a large positive value. The correlations between corresponding primary factors are given by the cosines of the angular separations between the primary vectors. These are shown in table 5. Most of the primary factors revealed here show rather small positive correlations The most conspicuous exception is the correlation between the primary factors A and E, which is .60. These two factors were interpreted as chest width and hip circumference. The low correlation between chest width (A) and chest depth (F) is of interest. One might have expected these two primary factors to be strongly correlated. The next highest correlation (+ .35) is between factors B and C, which we have interpreted as representing limb length and trunk size, respectively.

Before undertaking to investigate the relation between body measurements and temperament it will probably be best to identify the primary factors in body growth. This should be done by a detailed comparison of a number of factor studies that have already been made and by such additional factor studies as may be indicated. It would be of interest and practical importance to ascertain eventually whether any of these primary factors are definitely related to any temperamental traits.

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THE RELATIONSHIP OF STRENGTH TO PHYSIQUE[1]

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FIVE FIGURES

As a part of the study of intrinsic and extrinsic factors in the development of strength, physical characteristics were examined in a group of 80 boys from the public schools of Oakland, California, in relation to their performance on a series of dynamometric tests: right grip, left grip, pulling strength, and thrusting strength.[2] Cumulative physical and strength records for this sample of boys were collected at 6-month intervals from the fifth to the twelfth grade.

In the period of rapid growth, relationships between size and strength are affected by individual differences in physiological maturing. To control this factor, the present report will deal with measurements obtained near the end of adolescence, at approximately 17.5 years, when growth changes even in the late maturing are of very reduced magnitude.

At this age, the Pearson r for total strength with height was 0.33 ± 0.07 P. E., and for total strength with weight, 0.52 ± 0.055. The phrase "big and strong" is so common as to imply a very close association of these traits. The above correlations, however, indicate only a low to moderate relationship. With these coefficients we would not be surprised to find an inverse relation (small and strong, or big and weak) in a substantial proportion of cases. This can be examined more specifically in figure 1, which presents the correlation plot for strength and weight, with the regression lines shown. Each dot represents an individual case.

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[1] The writer is indebted to Dr. S. S. Stevens of Harvard University for furnishing somatotype assessments, and for suggestions concerning the manuscript. The material in this paper will be reported more fully in a book to be entitled "Motor Performance and Growth: a Developmental Study of Static Dynamometric Strength."

[2] Equipment and test methods for these functions will be described in the writer's book. Pulling strength is measured with the dynamometer at chest level, the 2 hands pulling in opposed directions. In the test of thrusting strength the 2 hands push inward on the dynamometer. "Total strength," as here used, is the sum of right and left grip, pull, and thrust.

Three cases (labelled E 7, A 5 and E 6) have been selected from this correlation plot for further discussion. Case E 6 is one of the weakest in strength measurements, but is slightly

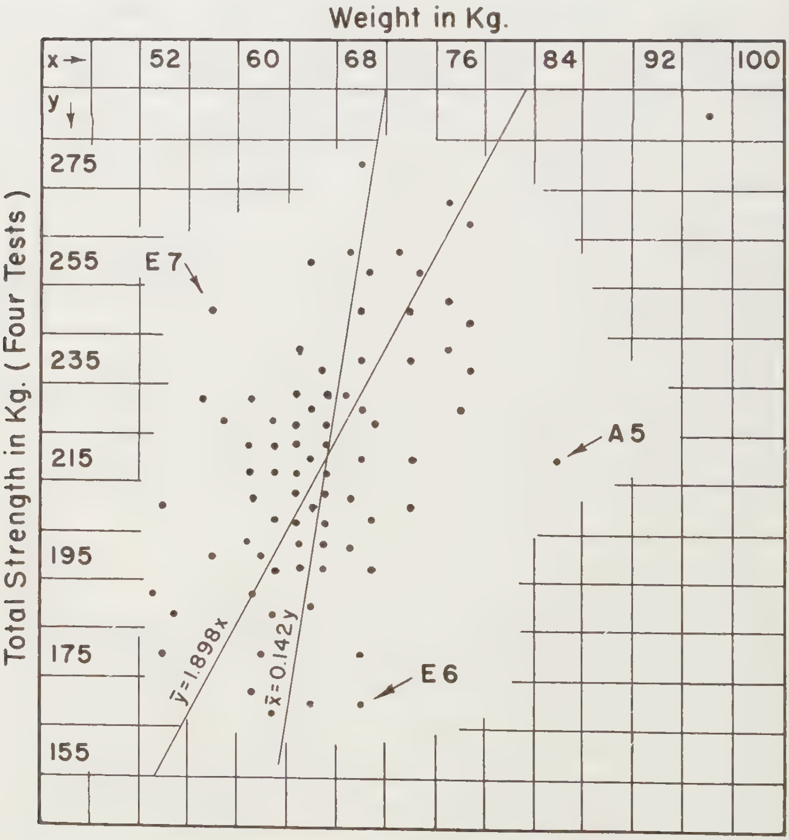

Fig. 1 Correlation chart, strength by weight.

above the average in weight. This latter is due, however, to his height; he is tall for his weight, and is relatively slender in arm, leg and chest circumferences.

Case A 5 is the second heaviest boy in the group, but he fails to equal the average in strength. Normal in height, he is more than 2 S. D. above the mean in weight and in various body circumferences. This excess in size, however, is due to fatty tissue rather than to muscular development. The physical examination record describes him (at 17.5 years) as "overweight, markedly above average in subcutaneous fat, with feminoid fat distribution."

In marked contrast is case E 7, a boy whose strength record is superior but who is about 1 S. D. below the group mean in weight, and 2 S. D. below the mean in height; in build he is solid, compact and muscular.

Since it is evident that factors of physique other than gross size are influential in determining strength, we may turn to a more systematic assessment of these factors. In a recent contribution to the theory and classification of body build, Sheldon, Stevens, and Tucker ('40, p. 5) have formulated the concept of 3 principal components, endomorphy, mesomorphy, and ectomorphy. In terms of this system of classification, the 3 cases identified in figure 1 as showing especially marked discrepancies between strength and weight are readily recognized as representatives of 3 different physical patterns. Two of these are relatively heavy but poorly muscled; 1 is strongly muscled but relatively small in size. Their body build assessments are as follows:

TABLE 1

Body build assessments of selected cases.[1]

CASE	ENDOMORPHY	MESOMORPHY	ECTOMORPHY
A 5	5.5	3.5	2
E 7	1.5	6	3
E 6	3	3.5	4.5

[1] The body build components are assessed on a 7-point scale in which 7 is high.

The first of these cases is a marked endomorph (an unusual body type in this sample). We have already noted that he is inferior in strength in relation to his size. The second case is an exceptionally clear example of a mesomorph, and although his strength is not among the highest in the group it is very great in relation to his size. The third subject is a slightly dominant ectomorph, with poor muscular development. The physical characteristics of these boys can be seen in figure 2, which presents outline drawings traced from body photographs which were taken at approximately 17.5 years.

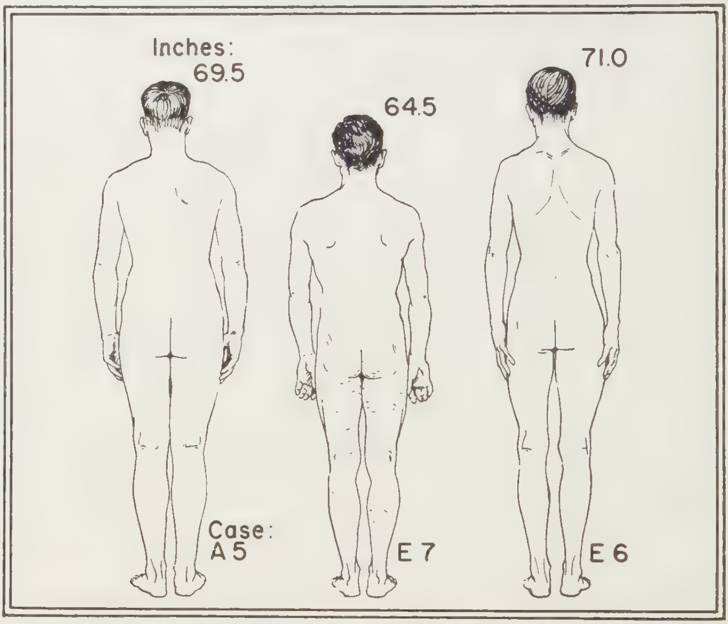

Fig. 2 Three boys of contrasting somatotypes.

A further comparison of ectomorphic and mesomorphic characteristics is given in figure 3, showing body form of 2 contrasting cases, at 4 age levels. These cases, E 31 and B 24, were chosen as individuals of similar mature height who presented contrasting extremes in physical constitution. Case E 31 has a powerful build, heavily muscled, and "well-knit" for physical activity. Case B 24 is slender and linear, with

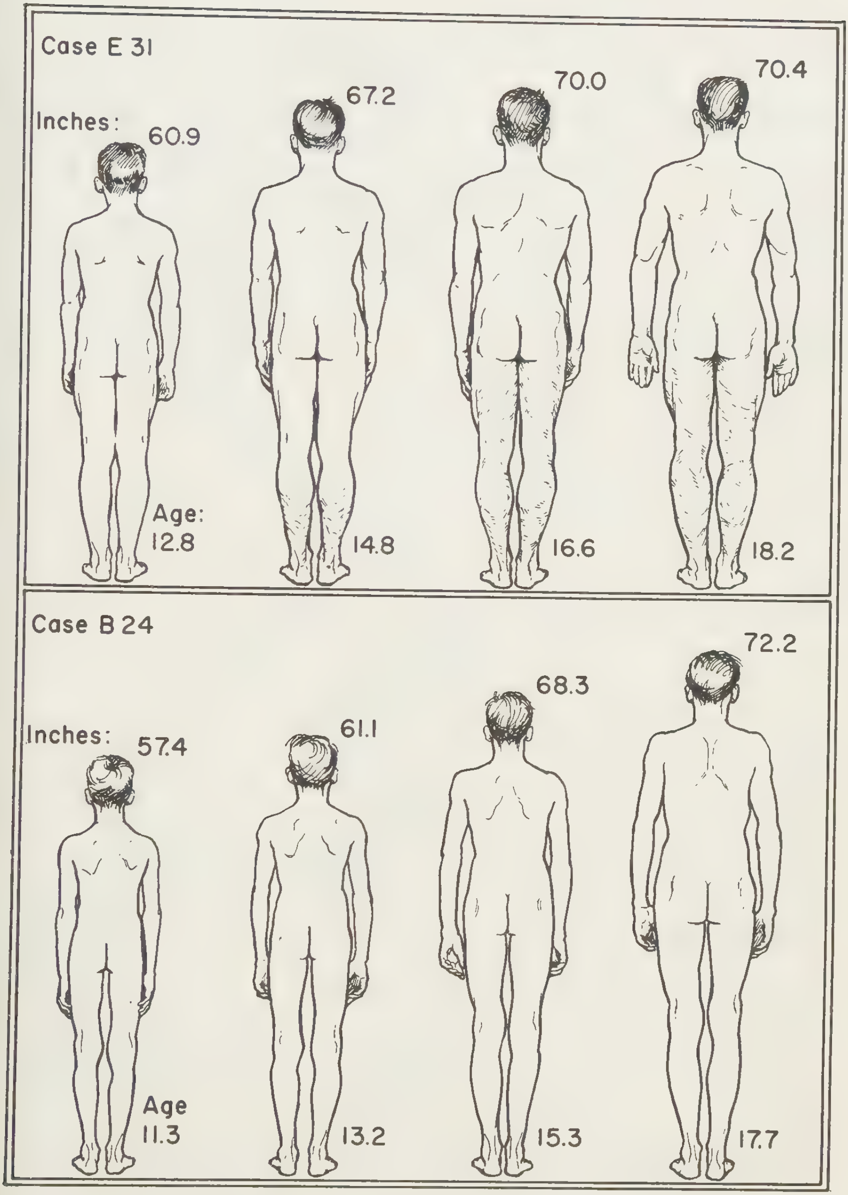

Fig. 3 Growth of a "Mesomorph" and an "Ectomorph."

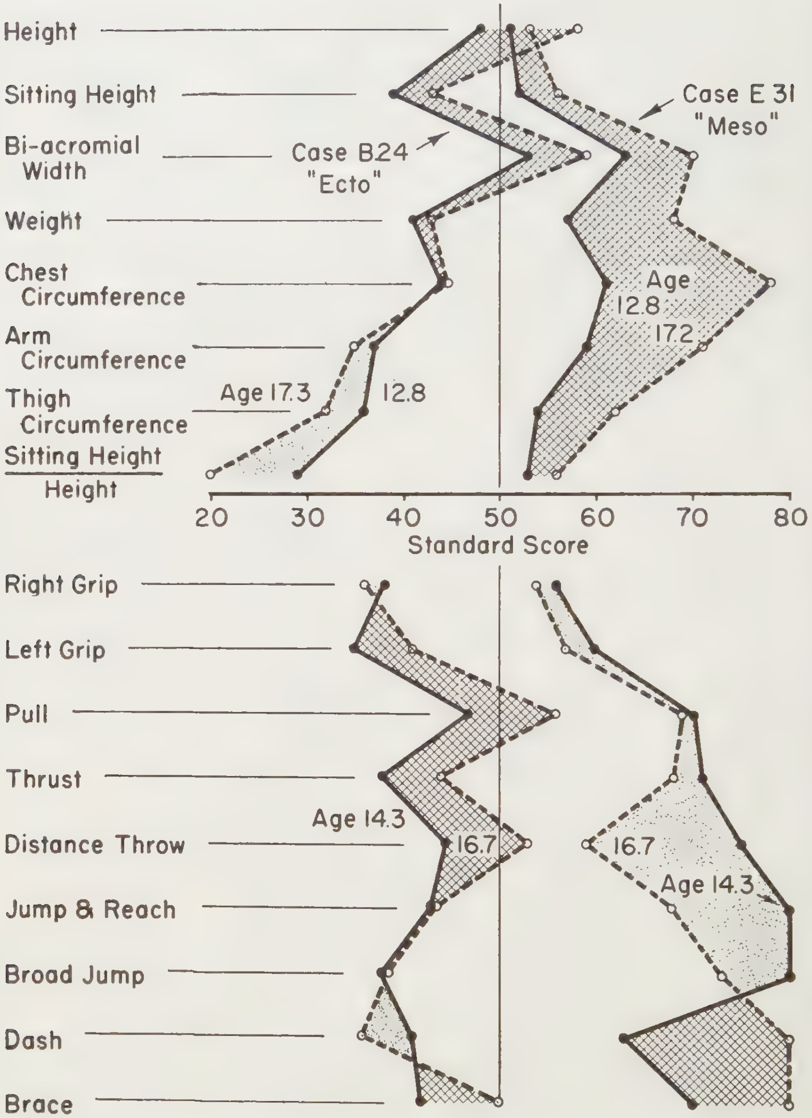

Fig. 4 Individual profiles, at 2 ages. (Physical measurements and motor performance.)

fairly broad shoulders but with a small chest circumference and slight muscular development.

The marked and persisting differences between the 2 boys in various aspects of physique and motor performance are clearly shown in figure 4, based on standard scores (in which the mean of the distribution is 50, with an S. D. of 10). In the physical measurements represented in the top half of this profile chart, E 31 is above average in each characteristic, and increasingly so when the later measurements at 17.2 years are compared with those at 12.8 years. B 24, on the other hand, is about 1 S. D. below the average in weight and chest circumference, with arms and legs of small diameter (the "pipestem" limbs characteristic of the marked ectomorph) and with a characteristically low sitting height/standing height index (i.e., with a short trunk and long legs in relation to total height). In the lower half of figure 4, somewhat similar differences are exhibited in motor performance at the 2 ages. The differences are quite marked in all functions involving manual, arm and shoulder strength, and are even more conspicuous in the case of performances based on leg strength.

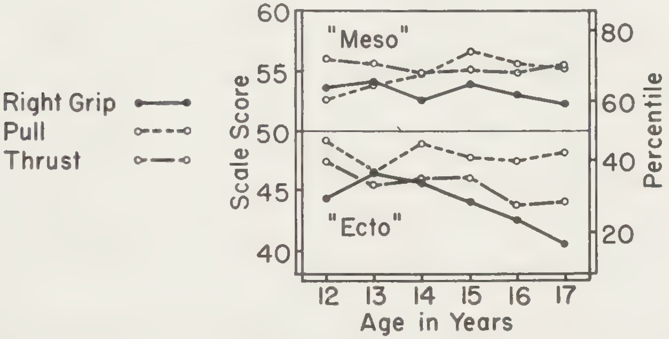

Fig. 5 Standard score age curves for strength. Averages of contrasting groups.

Similar differences are to be observed in figure 5, which presents average curves in strength (in terms of both standard and percentile scores) for the 10 boys who at maturity were most dominantly mesomorphic, and for the 10 most clearly ectomorphic. The strength superiority of the former group is manifest in the first year of study, and there is no tendency for the ectomorphs to overtake them; in fact, on 2 of the functions (grip and thrust) the latter group appear to decline, with age, in their relative position.

CORRELATIONAL ANALYSIS

For the group as a whole table 2 presents the interrelationships of total strength, the 3 components of body build, and weight and height; with the mean and S. D. for each. It can be seen that strength is moderately correlated with weight, height and mesomorphy, and to a slight degree negatively correlated with ectomorphy.

TABLE 2

Intercorrelations (Pearsonian r's) of strength and physical measurements — boys [1]

	VARIABLES	MEAN	S.D.	VARIABLES 1	2	3	4	5
0	Total strength (kg.)	216.3	26.2	.04	.34	—.25	.52	.33
1	Endomorphy	2.6	1.0		—.30	—.20	.37	.07
2	Mesomorphy	4.2	1.1			—.84	.09	—.51
3	Ectomorphy	3.8	1.1				—.14	.50
4	Weight (kg.)	65.5	7.2					.52
5	Height (cm.)	177.4	6.5					

[1] The sample of 80 cases falls in an age range from 17.3 to 17.7 years. In a few cases in which strength, weight or height data were available at adjoining ages but not at this age level, measures were interpolated (or extrapolated) for 17.5 years. Resulting errors may have reduced the correlations slightly, but the errors are of small magnitude, since changes are slight after 17 years.

The relation between strength and height is, however, restricted by the fact that many of the taller boys are ectomorphic. At the same time, the relation between strength and mesomorphy is, at least in this sample,[3] restricted by the fact that the mesomorphic build frequently reaches its best expression in short, stocky boys (as in case E 7 above). In such cases strength is handicapped not by lack of relative muscularity but by a small skeletal size and deficiency in total muscular mass.

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[3] For a college population, Sheldon and Stevens ('42) have reported markedly higher correlations between mesomorphy and strength: 0.64 in the case of peripheral'' or gripping strength; and 0.84 between mesomorphy and ''central'' or lifting strength. Their group, however, was somewhat more heterogeneous than the present sample.

When weight and height are partialled out, the correlation between strength and mesomorphy ($r_{02,45}$) becomes 0.61. The multiple correlation, $R_{0,12345,}$ between strength and the other variables in table 1 is 0.886. Thus we see that while no single physical factor is closely related to individual differences in strength, an appropriately weighted combination of 5 factors accounts for as much as 75% of the variance in strength. This would appear to leave only a small margin for other factors, such as those associated with the exercise or functional training of specific muscle groups.

Those who emphasize the role of intrinsic (as opposed to extrinsic) determiners in the development of functional traits will not be surprised by these results, and may take the further step of concluding that individual differences in both strength and physique are chiefly dependent upon common hereditary factors. It is, however, by no means unlikely that exercise and functional training have influenced individual differences by providing differential strengthening for those already endowed with the physique for strength; even when the same amount of training is provided for all, it is probable that individual differences will increase.[4] But under present conditions many of those who most need training become spectators, and those who least need it become performers. What is required, if we wish to reverse this process, is a much more highly selective system of physical education; educational objectives will determine whether or not this is desirable.

It may be pointed out that our present system is quite satisfactory if the chief objective is to extend the extreme range of achievement, making possible new and higher proficiencies of individual performers, and producing teams of performers which attain new records in competition with other teams. But if physical education is to be judged in terms of its success with those who have the greatest need, i.e., with those who are naturally less proficient, some question may justly be raised as to the adequacy of the methods now in effect. A program more specifically and more intensively adapted to individual needs should compensate, to some extent, differences due to biological factors, and enable the physically less gifted to compete on somewhat more even terms with those who have initial physical advantages. It is idle to expect individual differences to be eliminated or even very greatly reduced, but at least we might achieve a system in which these differences are less vigorously promoted.

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[4] Cureton ('41), for example has shown that the increase of muscular girth, in response to exercise, is greater among those of athletic (mesomorphic) build than among ectomorphs.

Quite aside from the above considerations, it would be a reasonable hypothesis that individual differences in strength are determined not only by structural factors revealed in muscular mass, the skeletal frame, etc., but also by neurophysiological factors. Thus we commonly think of the effectiveness of a strength response as depending not merely on gross bodily structures but also upon the functional organization of the response, sometimes described as the "knack" for the performance. From the present evidence, however, it does not appear likely that this variable is of generally great importance.

In summary, we have noted that strength is related both to body size (especially to weight) and to the mesomorphic component in body build. Mesomorphy, however, from our present evidence has little or no relationship to weight, and is negatively correlated with height. As a result, exceptions occur to the "big and strong" classification, as in cases of boys who are big but weak, or small but mesomorphic and strong. Taken alone, weight accounts for only 25% of the variance in strength, whereas 75% of the variance is controlled when the components of body build are included with weight and height, in proportions based on a multiple regression equation. In other words, static dynamometric strength is relatively independent of gross body size, but a combination of size and body build provide a fairly adequate representation of the factors determining strength.

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SHELDON, W. H., AND S. S. STEVENS 1942 The varieties of temperament. New York: Harpers, vii + 513 pp.

SHELDON, W. H., S. S. STEVENS AND W. B. TUCKER 1940 The varieties of human physique. New York: Harpers, xii + 347 pp.

REGIONAL CONTROL OF GROWTH.— The most important point to note [in connection with sequences of epiphysial union] is that the same regions, the same clusters of epiphyses, are easily recognized in a great variety of mammals. In fact one of the most fundamental and all pervasive features of mammalian growth, found from opossum to man, is that the factors determining growth exercise a regional control. This is essentially a "field concept," having much in common with Butler's theory of dental evolution. . . The conception that growth is controlled by regions rather than bone by bone or epiphysis by epiphysis, is of evolutionary importance. If changes in proportions can only be achieved by a large number of mutations affecting individual bones, the chances that so many beneficial changes will become the possession of any one population are fantastically small. However, if the same result can be attained by a single change in one region, the possibility of the rapid acquisition of favorable mutations is increased. For example, a single change in the growth rate of the knee region will produce the same effect as correlated changes in the femur, tibia, and fibula.— S. L. Washburn. The sequence of epiphysial union in the opossum. Anat. Rec., vol. 95, 1946, pp. 353–364.

SCIENCE IN SPAIN GAGGED BY THE FALANGISTS.— The Spanish edition of the Universal History edited by Walter Goetz (Espasa-Calpe, Madrid, 1945, 10 vols.) contains some comments by the "Spanish editors" which clearly imply a direct attack on the freedom of thinking. The chapter by Franz Weidenreich which should be entitled "Human evolution" has been labeled instead "The advent of man." In this connection there is a note by the "Spanish editors" which reads in translation as follows:

> This study by Weidenreich is extremely weak and propounds definitely old-fashioned theories. Today no one believes that man arose from "a world of animal forefathers." Lamarck's, Darwin's and Haeckel's evolutionist doctrines are out-dated and it is inconceivable that they should still appear in such a work as the present. Only the Bible presents us with admissible information on the origins of life, and all scientific discoveries do no more than confirm the veracity of the Mosaic account. Weidenreich himself, as far as man is concerned, has been obliged to acknowledge that everything speaks in favor of man's monogenetic origin.

It must be concluded that these comments are anonymous because it was impossible to get any scientist specializing in these problems to sign his name to such statements. The need for the comments undoubtedly was deemed indispensable by the publishers because they had ample reason to believe that without this editorial opinion the Universal History would have been forbidden publication by those reactionary ministers of the church who have taken upon themselves the task of dictating the very thoughts of the Spanish people. Such an opinion properly fits only the Middle Ages and certainly does not add to the reliability and prestige that the publishers have managed to maintain until now.— Juan Comas. (For a fuller statement see Cuadernos Americanos, no. 6, 1946, pp. 66–73.)

WORLD POPULATION INCREASE.— Between 1900 and 1940 the population of the earth increased faster than in any other similar period of its history. The annual per cent increase was 19% higher than between 1850 and 1900.— Population Bulletin, vol. 2, no. 3, March, 1946, p. 19.

A COMPARISON OF THE PERCENTAGES OF STILLBIRTHS AMONG SINGLE AND PLURAL BIRTHS IN THE TOTAL, THE "WHITE" AND THE "COLORED" U.S. POPULATIONS

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The frequency of stillbirths is higher among plural pregnancies than among single. General statements to this effect appear in many reference and textbooks. Rarely, however, are such statements supported by data, or if they are, the data are meager and not tested for statistical significance. Because of this lack of supporting figures and lack of satisfactory statistical analyses of those which do appear, it seems desirable to examine an extensive set of stillbirth frequencies and to publish the results of appropriate statistical tests. This we are doing in the present paper.

The data which we have selected for consideration are the stillbirth frequencies reported by the U. S. Bureau of the Census for the U. S. Birth Registration Area from 1922 to 1936 inclusive. Our reasons for choosing the 15-year interval which has been indicated we have discussed previously in our papers on the sex ratios and the plural birth frequencies within the U. S. populations for the same period of time (see Strandskov, '45a and b and Strandskov and Siemens, '46).

Some investigators may object to the utilization of the U. S. Census Records for the purpose which we have indicated on the grounds that the figures which are reported represent a wide variety of interpretations of the term stillbirth, and therefore do not present the true stillbirth picture for our nation. We are well aware of these major objections. We know that the different states within the United States follow different reporting rules in that some include deaths among fairly early stages of fetal development, whereas others include only fetuses born dead at or near full term. We also know that many very early fetal deaths and some later ones are not included among the reports of any state. Despite a knowledge of these facts we consider it justifiable to use the census data for the purpose proposed. All differences in recording between states, it seems to us, must be distributed fairly uniformly among the various types of births, i.e. single and plural births, and any necessary interpretation of the meaning of the term stillbirth can be allowed.

Stillbirths are generally expressed and compared in terms of what is known as the Crude Stillbirth Ratio. This is the ratio of the total number of stillbirths to the total number of live births multiplied by 1,000. We prefer, however, to obtain and compare the percentage that the number of stillbirths is of all births. This statistic has several advantages for the student of general human biology. One important feature of it is that it states approximately the probability that an embryo at conception, or shortly thereafter, has of being born dead. This the crude stillbirth ratio does not do.

Although we have indicated in the title that we are comparing the stillbirth percentages within the total and the two major components of the U. S. population, we are actually analyzing the percentages of fifty-four different groups. This number is the result of combining subgroups of the major populations in various ways. In order to conserve space in the listing of the subgroups in different combinations we have abbreviated them in the following manner: Wh. = white, Cl. = colored, Si. = single, Pl. = plural, Tw. = twin, Tr. = triplet and Qd. = quadruplet. Thus a population listed as Wh. Cl., Si. Pl., ♀ and ♂ means a population consisting of all female and male births in the total U. S. population.

The terms "white" and "colored" as used by the U. S. Bureau of the Census have no very specific meaning in the genetic sense. The term "white" probably includes only

Caucasoid stock but the term "colored" embraces all Mongoloid and Negroid peoples and also some Caucasoid. The group, which it represents is, nevertheless, largely of Negroid stock. Hence, any data regarding it may be considered fairly representative of the U. S. Negro population.

For each of the fifty-four populations which we are considering we have calculated the fifteen yearly percentages of stillbirths from 1922 to 1936 inclusive. We shall not, however, publish all of these detailed data. We shall present for each population only the total figures for the 15-year interval. These are given in table 1.

Since we are not publishing the yearly percentages of stillbirths for each population it is not possible for the reader to see how constant or how variable these percentages are within each population from year to year. Nevertheless, some information regarding this question can be gained from a consideration of the F values which are given in the last column of table 1. The statistic F, as presented here, is the extent to which the observed variance of each distribution of fifteen yearly percentages is greater or smaller than the variance expected due to chance. Fisher ('35) has shown that it is possible to calculate the probabilities of F values. Snedecor ('39) has provided us with a table of probabilities. For all populations except one, namely population no. 33, the observed variance is greater than the variance expected due to chance. When this is true, an F value of 1.69 has a probability of .05 and an F value of 2.07 a probability of .01. Hence, any F value greater than 1.69 (other than that listed for population no. 33) may be interpreted to mean that the observed variance is significantly greater than the variance expected due to chance.

As we have already indicated, our main purpose is to compare statistically the stillbirth percentages for the different types of birth of the different populations. This can be done by applying the standard formula for a test of the significance of the difference between two means:

$$t = \frac{\Delta}{\sqrt{\frac{\Sigma\,(X_1 - \dot{X}_1)^2 + \Sigma\,(X_2 - \dot{X}_2)^2}{N_1 + N_2 - 2} \times \frac{N_1 + N_2}{N_1\ N_2}}}$$

TABLE 1

The percentage of stillbirths among single and plural births in the total, the "white," and the "colored" U. S. populations.

POPULATION		TOTAL NO. OF BIRTHS SEX KNOWN	NO. OF STILLBIRTHS SEX KNOWN	% STILL-BIRTHS	F VALUE
No.	Composition				
1	Wh.Cl., Si.Pl., ♀♂	31,860,773	1,147,226	3.601	108.45
2	Wh.Cl., Si.Pl., ♀–	15,430,356	491,221	3.183	44.87
3	Wh.Cl., Si.Pl., ♂–	16,430,417	656,005	3.993	99.95
4	Wh.Cl., Si., ♀♂	31,117,925	1,090,471	3.504	150.15
5	Wh.Cl., Si., ♀–	15,065,083	465,891	3.093	48.76
6	Wh.Cl., Si., ♂–	16,052,842	624,580	3.891	104.59
7	Wh.Cl., Pl., ♀♂	742,848	56,755	7.640	5.26
8	Wh.Cl., Pl., ♀–	365,273	25,330	6.935	4.77
9	Wh.Cl., Pl., ♂–	377,575	31,425	8.323	3.23
10	Wh.Cl., Tw., ♀♂	731,360	55,099	7.533	4.68
11	Wh.Cl., Tw., ♀–	359,468	24,572	6.836	4.27
12	Wh.Cl., Tw., ♂–	371,892	30,522	8.207	11.92
13	Wh.Cl., Tr., ♀♂	11,232	1,604	14.281	2.44
14	Wh.Cl., Tr., ♀–	5,668	732	12.915	2.91
15	Wh.Cl., Tr., ♂–	5,564	872	15.672	1.44
16	Wh.Cl., Qd., ♀♂	256	51	19.922	...
17	Wh.Cl., Qd., ♀–	137	24	17.518	...
18	Wh.Cl., Qd., ♂–	119	27	22.689	...
19	Wh., Si.Pl., ♀♂	28,244,869	906,206	3.208	189.81
20	Wh., Si.Pl., ♀–	13,669,483	388,796	2.844	66.76
21	Wh., Si.Pl., ♂–	14,575,386	517,410	3.550	156.36
22	Wh., Si., ♀♂	27,605,090	863,405	3.128	227.60
23	Wh., Si., ♀–	13,355,589	369,704	2.768	71.52
24	Wh., Si., ♂–	14,249,501	493,701	3.465	160.71
25	Wh., Pl., ♀♂	639,779	42,801	6.690	1.14
26	Wh., Pl., ♀–	313,894	19,092	6.082	1.47
27	Wh., Pl., ♂–	325,885	23,709	7.275	2.14
28	Wh., Tw., ♀♂	630,460	41,650	6.606	1.04
29	Wh., Tw., ♀–	309,243	18,572	6.006	1.28
30	Wh., Tw., ♂–	321,217	23,078	7.185	2.29
31	Wh., Tr., ♀♂	9,123	1,113	12.200	2.37
32	Wh., Tr., ♀–	4,558	505	11.079	2.41
33	Wh., Tr., ♂–	4,565	608	13.319	1.09 [1]
34	Wh., Qd., ♀♂	196	38	19.388	...
35	Wh., Qd., ♀–	93	15	16.130	...
36	Wh., Qd., ♂–	103	23	22.330	...
37	Cl., Si.Pl., ♀♂	3,615,904	241,020	6.660	581.69
38	Cl., Si.Pl., ♀–	1,760,873	102,425	5.817	2.42
39	Cl., Si.Pl., ♂–	1,855,031	138,595	7.471	3.46
40	Cl., Si., ♀♂	3,512,835	227,072	6.464	58.43
41	Cl., Si., ♀–	1,709,494	96,188	5.627	23.53
42	Cl., Si., ♂–	1,803,341	130,884	7.258	33.80
43	Cl., Pl., ♀♂	103,069	13,948	13.533	2.42
44	Cl., Pl., ♀–	51,379	6,237	12.139	1.68
45	Cl., Pl., ♂–	51,690	7,711	14.918	2.62
46	Cl., Tw., ♀♂	100,900	13,444	13.324	2.61
47	Cl., Tw., ♀–	50,225	6,001	11.948	1.84
48	Cl., Tw., ♂–	50,675	7,443	14.688	2.62
49	Cl., Tr., ♀♂	2,109	491	23.281	2.64
50	Cl., Tr., ♀–	1,110	227	20.450	2.21
51	Cl., Tr., ♂–	999	264	26.426	3.68
52	Cl., Qd., ♀♂	60	13	21.667	...
53	Cl., Qd., ♀–	44	9	20.455	...
54	Cl., Qd., ♂–	16	4	25.000	...

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[1] This F value represents the number of times the variance due to chance is greater than the observed variance.

TABLE 2

The t values of comparisons between the stillbirth percentages among single and plural births in the total, the "white," and the "colored" U. S. populations.

POPULATION[1]		vs	POPULATION		t
No.	Composition		No.	Composition	VALUE
3	Wh.Cl., Si.Pl., ♂–	vs	2	Wh.Cl., Si.Pl., ♀–	13.68
6	Wh.Cl., Si. . ., ♂–	vs	5	Wh.Cl., Si. . ., ♀–	13.74
9	Wh.Cl., Pl. . ., ♂–	vs	8	Wh.Cl., Pl. ., ♀–	10.84
12	Wh.Cl., Tw. . ., ♂–	vs	11	Wh.Cl., Tw. . ., ♀–	12.03
15	Wh.Cl., Tr. ., ♂–	vs	14	Wh.Cl., Tr. . ., ♀–	3.01
21	Wh. . ., Si.Pl., ♂–	vs	20	Wh. . ., Si.Pl., ♀–	9.99
24	Wh. . ., Si. . ., ♂–	vs	23	Wh. . ., Si. . ., ♀–	9.67
27	Wh. . ., Pl. . ., ♂–	vs	26	Wh. . ., Pl. . ., ♀–	14.18
30	Wh. . . ., Tw. . ., ♂–	vs	29	Wh. . ., Tw. . ., ♀–	14.02
33	Wh. . ., Tr. , ♂–	vs	32	Wh. . ., Tr. , ♀–	2.64
39	Cl. . ., Si.Pl., ♂–	vs	38	Cl. . ., Si.Pl., ♀–	116.76
42	Cl. . ., Si. . ., ♂–	vs	41	Cl. . ., Si. . ., ♀–	11.59
45	Cl. . ., Pl. ., ♂–	vs	44	Cl. . ., Pl. . ., ♀–	8.79
48	Cl. . ., Tw. . ., ♂–	vs	47	Cl. . ., Tw. . ., ♀–	8.48
51	Cl. . ., Tr. . ., ♂–	vs	50	Cl. . ., Tr. . ., ♀–	1.99
7	Wh.Cl., Pl. , ♀♂	vs	4	Wh.Cl., Si. . ., ♀♂	50.57
8	Wh.Cl., Pl. ., ♀–	vs	5	Wh.Cl., Si. . ., ♀–	40.09
9	Wh.Cl., Pl. . ., ♂–	vs	6	Wh.Cl., Si. . ., ♂–	46.56
25	Wh. . ., Pl. , ♀♂	vs	22	Wh. . ., Si. . ., ♀♂	59.17
26	Wh. . ., Pl. , ♀–	vs	23	Wh. . ., Si. . ., ♀–	51.53
27	Wh. . ., Pl. , ♂–	vs	24	Wh. . ., Si. . ., ♂–	42.24
43	Cl. . ., Pl. , ♀♂	vs	40	Cl. . ., Si. . ., ♀♂	36.14
44	Cl. . ., Pl. , ♀–	vs	41	Cl. . ., Si. . ., ♀–	31.38
45	Cl. , Pl. , ♂–	vs	42	Cl. . ., Si. . ., ♂–	27.35
10	Wh.Cl., Tw. . ., ♀♂	vs	4	Wh.Cl., Si. . ., ♀♂	51.36
11	Wh.Cl., Tw. , ♀–	vs	5	Wh.Cl., Si. . ., ♀–	40.35
12	Wh.Cl., Tw. . ., ♂–	vs	6	Wh.Cl., Si. . ., ♂–	46.22
28	Wh. . ., Tw. . ., ♀♂	vs	22	Wh. . ., Si. . ., ♀♂	58.56
29	Wh. . ., Tw. . ., ♀–	vs	23	Wh. , Si. . ., ♀–	52.61
30	Wh. . ., Tw. . ., ♂–	vs	24	Wh. . ., Si. , ♂–	40.21
46	Cl. , Tw. , ♀♂	vs	40	Cl. . ., Si. . ., ♀♂	33.83
47	Cl. . ., Tw. , ♀–	vs	41	Cl. . ., Si. . ., ♀–	29.28
48	Cl. , Tw. ., ♂–	vs	42	Cl. , Si. . ., ♂–	26.45
13	Wh.Cl., Tr. , ♀♂	vs	4	Wh.Cl., Si. . ., ♀♂	20.48
14	Wh.Cl., Tr. , ♀–	vs	5	Wh.Cl., Si. . ., ♀–	12.69
15	Wh.Cl., Tr. , ♂–	vs	6	Wh.Cl., Si. . , ♂–	19.96
31	Wh. , Tr. , ♀♂	vs	22	Wh. , Si. , ♀♂	17.02
32	Wh. , Tr. , ♀–	vs	23	Wh. , Si. , ♀–	11.40
33	Wh. , Tr. , ♂–	vs	24	Wh. , Si. , ♂–	20.25
49	Cl. , Tr. , ♀♂	vs	40	Cl. , Si. , ♀♂	11.04
50	Cl. . , Tr. , ♀–	vs	41	Cl. , Si. , ♀–	8.10
51	Cl. . . Tr. , ♂–	vs	42	Cl. . Si. , ♂–	7.26
13	Wh.Cl., Tr. , ♀♂	vs	10	Wh.Cl., Tw. , ♀♂	12.67
14	Wh.Cl., Tr. , ♀–	vs	11	Wh.Cl., Tw. , ♀–	7.74
15	Wh.Cl., Tr. , ♂–	vs	12	Wh.Cl., Tw. ., ♂–	12.50
31	Wh. , Tr. ., ♀♂	vs	28	Wh. , Tw. . ., ♀♂	10.49
32	Wh. , Tr. , ♀–	vs	29	Wh. , Tw. . ., ♀–	6.92
33	Wh. , Tr. , ♂–	vs	30	Wh. , Tw. . ., ♂–	12.57
49	Cl. . ., Tr. , ♀♂	vs	46	Cl. . , Tw. . ., ♀♂	6.49
50	Cl. . ., Tr. ., ♀–	vs	47	Cl. , Tw. . ., ♀–	4.60
51	Cl. , Tr. , ♂–	vs	48	Cl. , Tw. ., ♂–	4.49
37	Cl. , Si.Pl., ♀♂	vs	19	Wh. . Si.,Pl. ♀♂	31.56

TABLE 2 (*continued*)

POPULATION[1]		VS	POPULATION		t VALUE
No.	Composition		No.	Composition	
38	Cl..., Si.Pl., ♀-	vs	20	Wh..., Si.,Pl. ♀-	65.18
39	Cl..., Si.Pl., ♂-	vs	21	Wh..., Si.,Pl. ♂-	55.92
40	Cl..., Si..., ♀♂	vs	22	Wh..., Si..., ♀♂	29.96
41	Cl..., Si..., ♀-	vs	23	Wh..., Si..., ♀-	39.09
42	Cl..., Si..., ♂-	vs	24	Wh..., Si..., ♂-	29.79
43	Cl..., Pl..., ♀♂	vs	25	Wh..., Pl..., ♀♂	40.18
44	Cl..., Pl..., ♀-	vs	26	Wh..., Pl..., ♀-	31.04
45	Cl..., Pl..., ♂-	vs	27	Wh..., Pl..., ♂-	28.98
46	Cl..., Tw..., ♀♂	vs	28	Wh..., Tw..., ♀♂	37.81
47	Cl..., Tw..., ♀-	vs	29	Wh..., Tw..., ♀-	29.26
48	Cl..., Tw..., ♂-	vs	30	Wh..., Tw..., ♂-	28.30
49	Cl..., Tr..., ♀♂	vs	31	Wh..., Tr..., ♀♂	6.86
50	Cl..., Tr..., ♀-	vs	32	Wh..., Tr..., ♀-	4.77
51	Cl..., Tr..., ♂-	vs	33	Wh..., Tr..., ♂-	4.93

[1] The population with the larger percentage of stillbirths is presented first.

A t value greater than 2 has a probability less than .05 and, therefore, may be considered indicative of a significant difference. We have not made all of the possible comparisons but have selected sitxy-six pairs which, in our opinion, include all or at least most of those of interest. The t values of these are given in table 2. The quadruplet populations are not included in any of the comparisons because the yearly numbers of quadruplet births are too small to permit a statistical treatment.

In order to show more clearly the trend in stillbirth percentages among single, twin, triplet and quadruplet births we have listed thirty-six of the populations and their percentages in a certain logical order in table 3. If we examine this table we note that the percentage of stillbirths increases with each increase in number of embryos per pregnancy. In the first population listed, which is a combination of females and males among "white" and "colored" populations taken together, the increase in the percentages is from 3.504 among single births, to 7.533 among twins, to 14.281 among triplets and to 19.922 among quadruplets. The differences between the single and the twin percentages and between the twin and the triplet percentages are statistically significant (see table 2 for t values). This probably is also true for the difference between the triplet and the quadruplet percentages though they are not shown to be so in statistical terms because of lack of numbers among quadruplets. Thus, it seems justifiable to conclude that the percentage of stillbirths in the total U. S. population increases significantly with each increase in number of embryos per pregnancy, or as the mammalogist would say, with each increase in size of litter. The same statement holds true for the "white" and the "colored" populations considered independently for each other, and also for females and males considered separately in all the different populations.

TABLE 3

The percentage of stillbirths among single, twin, triplet and quadruplet births in the total, the "white" and the "colored" U. S. population, or the probability of death of an embryo if he or she is a member of a single, twin, triplet or quadruplet pregnancy in the total, the "white" and the "colored" U. S. population.

	SINGLE	TWIN	TRIPLET	QUAD.
Wh.Cl., ♀♂	3.504	7.533	14.281	19.922
Wh.Cl., ♀ –	3.093	6.836	12.915	17.518
Wh.Cl., ♂ –	3.891	8.207	15.672	22.689
t value of ♀ vs ♂	13.74	12.03	3.01	. . . . .
Wh. . ., ♀♂	3.128	6.606	12.200	19.388
Wh. . ., ♀ –	2.768	6.006	11.079	16.130
Wh. . ., ♂ –	3.465	7.185	13.319	22.330
t value of ♀ vs ♂	9.67	14.02	2.64	. . . . .
Cl. . ., ♀♂	6.464	13.324	23.281	21.667
Cl. . ., ♀ –	5.627	11.948	20.450	20.455
Cl. . ., ♂ –	7.258	14.688	26.426	25.000
t value of ♀ vs ♂	11.59	8.48	1.99	. . . . .

What probable explanations may be offered for this increase in stillbirth percentage with each increase in number of embryos per pregnancy? Obstetricians in general have emphasized premature births among plural pregnancies as a causal factor. De Lee ('38) writes as follows: "About 80 per cent of duplex pregnancies terminate before term and practically all triplets and quadruplet gestations do." According to De

Lee premature births frequently result in death due to atelectasis and general debility. Other conditions associated with premature birth may also be responsible for death.

Students of general human biology have tended to emphasize the competition aspects of plural pregnancies. For example Newman ('40) writes: "The main cause of the excessive prenatal mortality of twins and supertwins is crowding, using this term in the broad sense to include all damaging effects due to interference of one fetus with another."

Another causal factor is the tendency for some monozygotic twins, triplets and quadruplets to remain partially fused. Such joined embryos may either have a low chance of survival because of their union or because of the complications which they present in the birth process. Even completely separated or independently developed twins, triplets and quadruplets present problems at birth which increase the chance of death of one or more members of the set.

Maternal toxemia has sometimes been mentioned as a partial explanation for the increased percentage of fetal deaths among plural pregnancies. There probably is no question but what the incidence of maternal toxemia is higher among plural pregnancies than among single. At least Potter and Adair ('40) present evidence of this. They write: "Toxemia is notably more common in association with twin than with single pregnancies. It occurred in 24 per cent of 159 women delivering twins in the Chicago Lying-in-Hospital from 1931–1938, in comparison to only 7 per cent among the total number of patients with single pregnancies during the same period." Potter and Adair, however, tend to question maternal toxemia as a proven causal factor in fetal and neonatal deaths and consequently also as an explanation for the increased percentage of stillbirths among plural pregnancies. They found that "The incidence of neonatal and fetal death for the total 318 twins delivered was 14.4 per cent; for the twins delivered of toxemic mother, it was only 5 per cent."

Many other possible and probable causal factors of high stillbirth percentages among plural births could be mentioned.

We shall not, however, devote more space to this question. Most of the additional factors are listed if not dealt with in detail in standard reference and textbooks on obstetrics.

With an increase in the percentage of stillbirths with each increase in number of embryos per pregnancy seemingly established for man, at least for the various U. S. populations, it is of interest to examine the relationships among lower mammals. There are relatively few reports in the literature which deal with this question, but one or two give data of interest. Johansson ('32) in his very extensive treatment of multiple births in cattle, reports 0.93% stillbirths among single births and 4.93% among twins. Thus, in this normally uniparous mammal the relationship is similar to that in man. W. L. Williams in his chapter in Taussig's book on abortion, states that twin pregnancies in the mare are almost always terminated by abortion and that when a twin pregnancy does become established there is a grossly defective power of placental adjustment. He also states that twins in sheep are far more frequently aborted than are single, and that a majority of triplets are aborted. Wright ('29) in his studies on inbred lines of guinea pigs found varying results. In one line, called Family 13, he found that the percentage born dead increases with size of litter, as is true for man. However, in other inbred lines he found that litters of 3 or 4 give the lowest percentage of deaths. In his control stock he found relatively little effect of litter size on mortality percentages. He concludes that there are effects in the guinea pig, but that "the relations are neither linear nor parallel in different stocks." On the basis of these limited reports among different animal species it is not justifiable to draw any final conclusions, but it appears probable that among normally multiparous species of mammal the percentage of stillbirths does not usually increase with each increase in size of litter, except as abnormally high litter sizes are reached, whereas among normally uniparous species, such as cattle and man, it does so.

These indicated relationships between number of embryos per pregnancy and stillbirth percentages among normally uniparous and normally multiparous species are what one would expect. If the stillbirth percentage among normally multiparous species increased significantly with each increase in number of embryos per pregnancy such species would tend to become uniparous. On the other hand if the stillbirth percentage did not increase among normally uniparous species such species would tend to become multiparous. Whether or not the human species is tending to become more completely uniparous than it is now is a question which can not be answered with any degree of certainty but it seems probable that it may be. Someday man may lose the joy of twins, triplets, quadruplets and quintuplets.

Table 3 shows not only a significant increase in the percentage of stillbirths with each increase in the number of embryos per pregnancy, but also a significantly higher stillbirth percentage among the males than among the females of all the different types of births. (The t values of the sex comparisons are shown below the columns of each subdivision of table 3.) This significantly higher percentage of stillbirths among the males of single as well as twin and triplet births, considered separately, is in agreement with previous reports on the percentage of stillbirths among all births considered collectively.

The explanations which have been offered for this higher percentage of stillbirths among males are varied. Some obstetricians have emphasized the larger body and especially the larger head of the male fetus as a partial causal factor. According to them this larger head size presents some handicaps in the birth process. Other obstetricians have stressed the view that all male fetuses are constitutionally weaker. In support of this opinion they have presented the evidence that the percentage of fetal death is higher for males than for females at all stages of uterine development. It must be pointed out, however, that another possible explanation of the last mentioned fact is that lethal or semi-lethal sex linked recessive genes exist in the human population or appear as a result of mutations. According to genetic theory such genes, if they exist or appear, should tend to eliminate more male than female fetuses. This hypothesis is quite different from that which assumes that all males are constitutionally weaker just because they are males. In any event it seems probable that the sex differences with respect to stillbirth percentages are due almost exclusively to genetic factors.

If we examine table 3 for further details we note also that racial differences in the percentage of stillbirths exist. The percentages for the "colored" population are significantly higher for all of the different types of birth than are the corresponding percentages for the "white." (For the t values of the racial differences see table 2.) These population differences in stillbirth percentages probably are due largely to racial environmental differences. However it is not improbable that part of them may be due to heredity. That genetic factors can affect stillbirth percentages we know from several different lines of evidence. Let us recall that Wright ('29) found significant differences in stillbirth percentages among different inbred lines of guinea pigs reared under identical environmental conditions. The factors responsible for these differences must have been genetic. Furthermore, within the human species we know of a number of genes which produce lethal or semi lethal effects. It is not unreasonable to assume that such genes might have different frequencies in different racial groups and consequently produce different stillbirth percentages. In fact we actually know of one series of alleles in the human species whose genes do produce lethal effects and do have different frequencies in different racial groups. We are referring to the Rh series of alleles. The Rh blood factor, it may be recalled, was discovered by Landsteiner and Wiener in 1940 and shown by them and others to have a hereditary basis (see Landsteiner and Wiener, '41, Wiener and Sonn, '41, and others). In 1941 Levine and his associates related this inherited blood factor to the hemolytic disease of the fetus or newborn child, known as erythroblastosis fetalis, which frequently is fatal shortly before or after birth. Thus there is no question but what the Rh blood factor represents an inherited condition which affects stillbirth percentages.

Furthermore Levine ('42) and Wiener, Sonn and Belken ('43), as well as others, have shown conclusively that Caucasoid, Mongoloid and Negroid populations have somewhat strikingly different Rh gene frequencies. This can only mean that these racial groups have different frequencies of erythroblastosis fetalis and consequently different stillbirth percentages due to this disease. We must admit, however, that the differences between races in the relationships of the Rh gene frequencies are such that we should expect a lower incidence of erythroblastosis in the "colored" population than in the "white." Hence the observed higher stillbirth percentage in the "colored" population can not be attributed to the inherited Rh blood factor. We introduced this blood factor merely to illustrate how genetic factors may be responsible for racial stillbirth percentage differences, rather than to present it as an explanation for the higher percentages in the "colored" population.

We should like now to look at the stillbirth percentages from a slightly different point of view. Since the figures listed in table 3 are the percentages that the stillbirths of a given population are of all the births in that population, they may also be considered as the approximate probability that an embryo or fetus has of dying before or at the time of birth. For example, a developing embryo in a single pregnancy in the U. S. population, ignoring race and sex, has a probability of about 3.504% of dying before or at the time of birth. Each of the other percentages listed in table 3 may be interpreted in a similar manner, i.e. as the probability of uterine death of an embryo in a given type of population.

From a psychological point of view we probably should have listed the probabilities of survival of embryos rather than the probabilities of uterine death. If someone desires these probabilities they can, of course, be obtained directly by subtracting the probabilities of uterine death from 100%. Fortunately these probabilties of survival are much higher than are those for death. Yet they certaintly are not as high as man should like them and probably they are not as high as they can be brought by improving the environment and perhaps also by improving the hereditary make up of the human species.

SUMMARY

1. The stillbirth percentages among single, twin, triplet and quadruplet births in the total, the ''white'' and the ''colored'' U. S. populations from 1922 to 1936 are presented and compared.

2. In each of the three populations the stillbirth percentage increases significantly with each increase in number of embryos per pregnancy or as the mammalogist would say, with each increase in size of litter. The probable causes of the increase are briefly discussed.

3. The percentage of stillbirths is shown to be significantly higher among males than among females in the different types of births, i.e. in the single, twin and triplet births. It is concluded that the sex differences are due primarily to genetic factors.

4. The percentage of stillbirths is shown to be significantly higher among the single and the plural births of the ''colored'' population than among the corresponding births of the ''white.'' The responsible factors are concluded to be primarily environmental. Evidence, however, is presented which indicates that genetic factors could be partly responsible.

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Diet and Tooth Eruption.— From many years of controlled research covering the first year of postnatal life [Drs. Philip C. Jeans and Genevieve Stearns] have formulated the following views: (a) 300–800 U.S.P. units of vitamin D daily promotes accelerated rate of growth in stature, increased calcium and phosphorus retentions, and early eruption of teeth; (b) less than 125 units is ordinarily insuffícent for ''maximum effect''; and (c) 1500–2000 units usually has a ''depressing (toxic) action.'' In terms of this view there is no lack of harmony between the finding of early tooth eruption for infants receiving 300–400 units (maximum effect) and the findings of later ages of eruption both for infants fed 110 units (increasing effect but not maximum) and for those fed 1500 units (decreasing effect).— Howard V. Meredith. Order and age of eruption for the deciduous dentition. J. Dent. Res., vol. 25, 1946, pp. 43–66.

A NOTE ON THE DURATION OF LIFE OF THE ANCIENT INHABITANTS OF ANATOLIA

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Vallois ('37) investigated the longevity of the fossil hominids and concluded that their duration of life was relatively brief, on account of their rude and precarious life, and that the increase in average longevity of man occurred relatively recently.[1] Because of this interesting study, it was decided to investigate the age at death of the ancient inhabitants of Anatolia to see to what extent these conclusions were applicable to these metal age peoples. Initially only remains from the Chalcolithic, Copper, Hittite and Phrygian periods were studied and the results were briefly stated in a former paper (Şenyürek, '46). Subsequently this series was enlarged by the addition of skulls from the Medo-Persian-Hellenistic and Roman-Byzantine periods, and the results are reported herein.

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[1] Vallois ('37, p. 531) makes the following statement:

"Une dernière question serait enfin la recherche de la cause de la mortalité si précoce de nos ancêtres. Il paraît tout naturel d'y voir une conséquence du mode de vie très primitif qu'ils devaient mener. Les peuples paléolithiques et mésolithiques, qui s'adonnaient uniquement à la chasse et à la cueillette, se trouvaient par là exposés a maints dangers et à maintes privations: leur vie rude et précaire ne devait guère permettre la survie des individus affaiblis par l'âge. Ce n'est qu'avec la découverte de l'agriculture, qui a entraîné une existence sédentaire et la possibilité de constituer des réserves alimentaires, que les sujets âgés se sont trouvés à même de subsister. Encore ce que nous avons vu plus haut montre-t-il que, même à des époques où la vie agricole était largement développée, comme à l'âge du Bronze ou dans l'Egypte romaine, le nombre des vieillards était bien plus faible que de nos jours. Ce n'est vraiment que depuis le dernier siècle, et sous l'influence du brusque accroissement de bien-être dû à l'épanouissement de la civilisation occidentale, qu'en Europe du moins, l'âge moyen de la vie s'est notablement allongé."

Altogether 112 specimens, from various sites, were studied, representing the majority of the material preserved in the Department of Anthropology of the University of Ankara. Of this collection only a few skeletons from Arslantepe and Kumtepe have not yet been incorporated in this series. Skulls from most of the sites listed (table 1) have already been described (for bibliography, see Şenyürek, '41). On the Samsun skeletons so far only a preliminary report has appeared (Kökten et al., '45). The skulls from Karaoglan, Pazarli and Yazılıkaya and some new specimens from Alaca Höyük had not yet been described at the time of the writer's departure for the United States.

The skulls studied range from the Chalcolithic to Roman-Byzantine times. According to von der Osten ('37) Chalcolithic begins in the second half of the fourth millenium B.C. and the Roman-Byzantine time at Alishar Höyük ends in the eleventh century A.D. (According to Özgüç, '45, Chalcolithic begins at about 3200 B.C.). In this study all, whole or fragmentary, cranial remains capable of yielding a reliable age estimate were used, and only those in a hopeless condition were eliminated.

The age was determined by means of the stages of eruption of the teeth and the union of sutures, excepting 2 specimens where epiphyses were also used.[2] Observations were made both ecto- and endocranially in the majority of the cases. At first the age was determined on the basis of the ectocranial closure, for which a summary of Martin's ('28) data given by

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[2] In this study 2 cases of premature suture closure were encountered, both in the Copper period. In the first, a child in whom, of the permanent set of dentition, only the first permanent molar had erupted, the sagittal suture had closed both endocranially and ectocranially and the coronal suture had fused partly on the inner and outer sides. In the second skull, in whom the wisdom teeth had not yet erupted, sagittal suture had closed both endocranially and ectocranially, while the lambdoid suture showed partial synostosis inside but was still patent outside. As the region of the basilar suture was broken, to make sure that we were not dealing here with a delayed eruption of the wisdom teeth, epiphyses of the available tibia and humerus were checked and the age was determined as about 17–18 years. Another specimen where the epiphyses were used for control is about 15–16 years old.

Vallois ('37, fig. 1 and table 1) was utilized. Afterwards the data were studied in relation to the endocranial figures of Todd and Lyon ('24), which were also applied to the few cases where the ectocranial surface alone was observed. Both methods of assessing age yielded the same general result, namely, that the ancient Anatolians died relatively young. In the ensuing tables all the figures given are those obtained by Todd and Lyon's method. No corrections have been made for individuals where only the ectocranial surface was observed (to these also endocranial figures have been applied), as they were in their early twenties, excepting 2 which were definitely old.

In the following tables the Anatolian series is arranged according to culture periods. The figures given in tables 3 and 6 appertain to the series studied by the writer. In tables 4 and 7 to these, some skulls studied by Angel ('39) and Ehrich ('40) have been added, bringing the total to 122.

A few words should be said regarding the age findings among previous studies on ancient Anatolians. A skull from Babaköy is described as a middle-aged male of 50 years or less (Angel, '39) and of 9 skulls from Tarsus (Gözlü Kule), ranging between Chalcolithic and Roman periods, only one, a Roman period individual, is given as middle-aged, others being younger (Ehrich, '40).[3] Of 5 Alaca Höyük skulls Kansu and Tunakan ('45) give 4 as under 20 and 1 as older. The same skulls were also studied by the writer and are incorporated in his larger Alaca series. Of 5 fragmentary Maşat skulls (Şenyürek, '46) 3 are under 20 and 2 older, but there is

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[3] The ages and sexes of all the Gözlü Kule specimens used in this study are as follows (from Ehrich, '40):

Chalcolithic?: nos. 9, 10, 13, 14 (7–12 yrs.), no. 11 (13–17 yrs. ♂).

8 M. level (ca. 2000 B.C.): no. 15 (young adult, ♀).

Hellenistic: no. 17 (subadult, ♀).

Roman: no. 16 (young adult, ♀), no. 18 (middle-aged, ♂).

As Dr. Ehrich has kindly informed the writer that he has followed our teacher Prof. Hooton's age classification in general, subadult and young adult have been respectively placed in 13–20 and 21–40 year groups, and middle-age has been tentatively put in 41–60 group, as according to Hooton's system this group covers from 36 to 55.

TABLE 1

Skulls studied by the writer according to site and period.

SITE	PERIOD	NO. OF INDIVIDUALS
Ahlatlıbel	Copper	4
Alaca Höyük	Chalcolithic	4
	Copper	11
	Early Bronze	1
	Hittite Empires	2
Alişar Höyük	Copper	2
	Early Bronze	2
	Hittite Empires	9
	Post-Hittite-Phrygian	2
	Medo-Persian-Hellenistic	3
	Roman-Byzantine	9
Karaoglan [1]	Hittite Empires	1
	Post-Hittite-Phrygian	3
Kusura	Chalcolithic-Copper	5
	Hittite Empires	2
Maşat Höyük	Copper	3
Pazarlı [2]	Post-Hittite-Phrygian?	8
	Medo-Persian-Hellenistic?	7
Sites around Samsun	Copper	21
Tilkitepe	Chalcolithic	6
	Copper	4
	Chalcolithic or Copper	2
Yazılıkaya ("Midas City") [3]	Post-Hittite-Phrygian?	1
Total		112

[1] One of the specimens attributed to the Post-Hittite-Phrygian period (no. Vi) may be of classical date.

[2] According to the excavator, Dr. Koşay (Les fouilles de Pazarlı . . . Publications of the Turkish Historical Society, series v, no. 4, 1941) the skeletons from the citadel of Pazarlı may belong to earlier periods and even to the Phrygians. Again, according to the excavator the top of the tumulus was used as a cemetery in the classical times. Therefore, the specimens from the citadel have been tentatively assigned to the Post-Hittite-Phrygian period and those from the tumulus to the Medo-Persian-Hellenistic epoch.

[3] According to the accompanying note of the archaeologists, this calva, found at the bottom of a reservoir, is probably older than other things found there and may go back to the eighth century B.C. Thus it has been tentatively placed in the Post-Hittite-Phrygian period.

no evidence to show that the latter had passed their middle-age. As the latter 2 remains are of too fragmentary a nature, preventing a definite age assessment, they have not been included in the present study.

TABLE 2

Skulls studied by other investigators.

SITE	BABAKÖY (ANGEL, '39)	GÖZLÜ KULE, TARSUS (EHRICH, '40)				TOTAL
Period	Early Copper?	Chalcolithic? Early Cemetery	8 M. Level ca. 2000 B.C.	Hellenistic?	Roman	
Number of individuals	1	5	1	1	2	10

TABLE 3

Age distribution of deaths among the ancient inhabitants of Anatolia. Series studied by the writer. Both sexes.

PERIOD	0–12 YRS.	13–20 YRS.	21–40 YRS.	41–60 YRS.	61–X YRS.	TOTAL NO. OF INDIVIDUALS
Chalcolithic-Copper	13 (20.9%)	8 (12.9%)	22 (35.4%)	15 (24.1%)	4 (6.4%)	62
Early Bronze	....	1 (33.3%)	1 (33.3%)	1 (33.3%)	....	3
Hittite Empires	2 (14.2%)	1 (7.1%)	9 (64.2%)	1 (7.1%)	1 (7.1%)	14
Post-Hittite-Phrygian	2 (14.2%)	2 (14.2%)	7 (50.0%)	2 (14.2%)	1 (7.1%)	14
Medo-Persian-Hellenistic	3 (30.0%)	....	6 (60.0%)	1 (10.0%)	....	10
Roman-Byzantine	1 (11.1%)	2 (22.2%)	3 (33.3%)	2 (22.2%)	1 (11.1%)	9
Total series	21 (18.7%)	14 (12.5%)	48 (42.8%)	22 (19.6%)	7 (6.2%)	112

The incidence of child deaths in table 4 is not high, which is also true for most of the period series (table 3). Probably more reliable data in this respect are provided by Krogman's ('37) larger Alishar Höyük series, of which a part is preserved in the Department of Anthropology of University of Ankara. The figures shown in table 5 have been taken from Krogman ('37, table 1).[4] It is observed that the incidence of child mortality in the total Alishar series (33.1%) is much higher than that for this study (20.4%), which is also true of the period series. These Alishar figures probably reflect more nearly the prevailing conditions of child mortality in ancient Anatolia. Krogman's figure for Chalcolithic and Copper periods combined (29.3%) is higher than the writer's,[5] but the figure for the Copper period (19.5%) must be considered low. Since child mortality was heavier in the subsequent periods of Alishar, we may assume that it was probably also higher than 19.5% in the Copper period of this Höyük (mound). It must be kept in mind that the immature skeletons, especially those of young infants when mortality is particularly heavy, are relatively more perishable and liable to disintegrate in the ground or the excavators may fail to find or record them. Therefore, it is considered probable that the actual child mortality may have been still higher than even the Alishar figures.

TABLE 4

Age distribution of deaths among the ancient inhabitants of Anatolia — Both sexes.

	0–12 YRS.	13–20 YRS.	21–40 YRS.	41–60 YRS.	61–X YRS.	TOTAL NUMBER OF INDIVIDUALS
Total series, including Angel's and Ehrich's material.	25 (20.4%)	16 (13.1%)	50 (40.9%)	24 (19.6%)	7 (5.7%)	122

Nevertheless, tables 3 and 4 reveal that in both the total and various period series the majority of the available

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[4] Krogman ('37, table 1) lumps all the adults together. In table 5 his 0–7 and 7–14 years groups have been combined.

[5] Together with Angel's and Ehrich's Chalcolithic? material child mortality for the Chalcolithic-Copper period in the writer's series rises to 25.0% which is still lower than that for Alishar.

Anatolian skulls (about three-fourths of the total and from 66.6 to 90% of the period series) belong to individuals under 40 years of age and that really aged individuals are rare in all periods. In other words, it appears that in ancient Anatolia death at a relatively early age was the norm and average longevity was shorter than in recent civilized man.

TABLE 5

Age-groupings of the skeletons excavated at Alişar Höyük (adapted from Krogman's table 1, 1937). Both sexes.

	BIRTH TO 14 YRS.	14 TO 21 YRS.	ADULT	TOTAL
Chalcolithic Age	8 (66.6%)	1 (8.3%)	3 (25.0%)	12
Copper Age	9 (19.5%)	3 (6.5%)	34 (73.9%)	46
Early Bronze Age	..	1 (20.0%)	4 (80.0%)	5
Hittite Empires	29 (40.2%)	5 (6.9%)	38 (52.7%)	72
Post-Hittite-Phrygian	3 (37.5%)	....	5 (62.5%)	8
Medo-Persian-Hellenistic	4 (36.3%)	....	7 (63.6%)	11
Roman-Byzantine	7 (25.9%)	4 (14.8%)	16 (59.2%)	27
All periods from the Chalcolithic Age to Roman-Byzantine times considered together.	60 (33.1%)	14 (7.7%)	107 (59.1%)	181

However, this does not mean that they did not have the potentiality of living to a ripe old age. Indeed, the presence of aged individuals in most of the period series — except in the early Bronze and Medo-Persian-Hellenistic periods, where their absence may be considered accidental — indicates that the peoples of all these periods had this potentiality, but living conditions were apparently such that only a small percentage succeeded in living to be old.

The percentages of old age deaths in Chalcolithic-Copper, Hittite and Post-Hittite-Phrygian periods do not differ much. Only in the Roman-Byzantine period does the percentage of old age death increase perceptibly. But this difference in this small series is caused by a single individual, so that it is at

TABLE 6

Sex difference in the age at death among the ancient inhabitants of Anatolia. Series studied by the writer.

PERIODS	SEX	13–20 YRS.	21–40 YRS.	41–60 YRS.	61–X YRS.	TOTAL NUMBER OF INDIVIDUALS
Chalcolithic-Copper	♂	2 (6.4%)[1]	14 (45.1%)	12 (38.6%)	3 (9.6%)	31
	♀	5 (29.4%)	8 (47.0%)	3 (17.6%)	1 (5.8%)	17
Early Bronze	♂	1 (33.3%)	1 (33.3%)	1 (33.3%)	...	3
	♀		.	...	. .	. .
Hittite Empires	♂	1 (10.0%)	8 (80.0%)	1 (10.0%)	...	10
	♀		1 (50.0%)	...	1 (50.0%)	2
Post-Hittite-Phrygian	♂	...	3 (60.0%)	2 (40.0%)	...	5
	♀	2 (28.5%)	4 (57.1%)	...	1 (14.2%)	7
Medo-Persian-Hellenistic	♂	...	4 (80.0%)	1 (20.0%)	...	5
	♀	...	2 (100.0%)		...	2
Roman-Byzantine	♂	...	1 (25.0%)	2 (50.0%)	1 (25.0%)	4
	♀	2 (50.0%)	2 (50.0%)	.	...	4
Total series	♂	4 (6.8%)	31 (53.4%)	19 (32.7%)	4 (6.8%)	58
	♀	9 (28.1%)	17 (53.1%)	3 (9.3%)	3 (9.3%)	32

[1] A specimen of indeterminate sex included in previous tables has been omitted.

present difficult to consider this as a reliable sign of increase in average longevity. It will be safer to defer the question as to whether the average longevity increases from the Chalcolithic-Copper period to Roman-Byzantine times until more material comes to light. It may also be mentioned that differences also occur between the various sites. If we compare the Chalcolithic-Copper material studied from Alaca Höyük, discovered in continuous excavations up to the end of 1945, and Tilkitepe as an example, it is found that they are different in that the percentage of individuals under 40 years of age in the former is considerably higher than in the latter, while the reverse is true for individuals over 40. But it is considered that at present it is impossible to draw any reliable conclusions from such differences, as they may very well arise from the scantiness of the material.

TABLE 7

Sex difference in the age at death among the ancient inhabitants of Anatolia.

ANCIENT ANATOLIA	SEX	13–20 YRS.	21–40 YRS.	41–60 YRS.	61–X YRS.	TOTAL NUMBER OF INDIVIDUALS
Total series, including Angel's and Ehrich's material	♂	5 (8.1%)	31 (50.8%)	21 (34.4%)	4 (6.5%)	61
	♀	10 (28.5%)	19 (54.2%)	3 (8.5%)	3 (8.5%)	35

It is evident that the result of this study is in harmony with studies of Vallois ('37), and an earlier one by Todd ('27), in that in these metal age peoples the average longevity appears to be relatively shorter than in recent civilized man.

A reference to table 7 indicates that among the ancient Anatolians female mortality exceeded that of the males in the earlier periods of life, which is also true of the periods (table 6), with the seeming exception of the Hittite series where the females are represented by only 2 specimens. Conversely, the numbers of males in the older age groups are higher than those of the females, again with the exception of Hittite and Post-Hittite-Phrygian periods, the latter condition also being reflected in the total series. But as this condition does not occur in other periods, it is difficult to consider it as a sure indication that once the maturity was safely reached proportionately more women than men lived to be old, as there is the possibility that it may be due to the scantiness of the material. At any rate, irrespective of the variation in 61-x group, the figures indicate that mortality in the earlier periods of life was relatively heavier among the females than males. The approximate average age at death of the females is considerably lower than that of the males. Eliminating individuals under 13 years of age, in the total series, the approximate average age of death for these Anatolians is 35 years for 58 males and 28 years for 32 females.[6]

As has been respectively noted by Franz and Winkler ('36) and Vallois ('37), among the Bronze age (Aunjetitz period) people of Austria and the Egyptians of the Roman period, too, the percentage of female mortality in the earlier periods of life, between the ages of 14 and 40 years, is higher than that of the males (for comparative figures see Franz and Winkler, '36, p. 162, and Vallois, '37, p. 530).[7] According to the information given by Vallois ('37), the same is also true of Neanderthal, upper Paleolithic and the Mesolithic men. That is, this relation appears to be rather common among the early peoples.

Franz and Winkler ('36) attribute the greater female mortality in earlier life mainly to the function of childbearing. Vallois ('37) accepts this, but advances as an additional explanation the relatively slower rate of sutural union in the

[6] Angel's and Ehrich's material is not included.

[7] A detailed comparison is beyond the scope of this brief note. But it may be pointed out here that the age distribution of deaths among the ancient Anatolians, though there are some differences, in general comes near to that of these Bronze age Austrians and Egyptians of the Roman period (compare with Vallois, '37, table 5 and also Franz and Winkler, '36, table 2). In all 3 of these metal age series the old age death is still rarer than in modern civilized man (compare with Franz and Winkler, '36, table 2 and Vallois, '37, table 5). There are some slight clerical errors in Vallois' Egyptian percentages, which must be considered in a comparison.

females ('37, p. 531). In the writer's opinion, though the slower rate of sutural union in females may be to some extent involved in individuals over 20, the observed percentage differences in mortality between the sexes, corresponding in general with the childbearing period, must be largely attributed to the hazards of childbearing.

SUMMARY

1. It appears that, though they had the potential of longevity, most of the ancient Anatolians died at a relatively early period of life. In other words, their average longevity appears to have been relatively briefer than that of modern civilized man.

2. It appears that the mortality among the females in the earlier periods of life was relatively heavier than that among the males. Though the slower rate of sutural union in the females may also be to some extent involved, this observed percentage difference in mortality between the sexes in the earlier periods of life, corresponding in general with the childbearing period, must be largely attributed to the hazards of childbearing.

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THE NUMBER OF VERTEBRAE IN THE FETAL BANTU SACRUM[1]

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INTRODUCTION

The purpose of this paper is to present data suggesting that the fetal sacrum contains normally 6 vertebrae. As observations were made on only 20 fresh fetal sacra, it was considered necessary, in drawing such an unexpected conclusion, to have adequate statistical support for data derived from such a small sample. The problem was assessed statistically by Kerrich, who agrees with Heyns' conclusions and has given the statistical verification at the end of this communication.

Research into the ontogenetic development of the Bantu pelvis demanded laborious cleaning of specimens on excision from the fetal body. It was soon obvious that determination of the number of sacral segments was difficult. So much dissection at the terminal end of the sacrum was required that the labor involved seemed unjustifiable, if indeed it was possible even then to gain a precise estimate of the numerical constitution of the sacrum. It was accordingly decided to deal with all fetal sacra as 5-piece units. Careful cleaning of the lower end of the sacrum in a few specimens, however, showed in each case that 6 vertebrae were fused together, a finding which led to the suspicion that in the fetal sacrum the cartilaginous lateral mass extended distally in such a manner as to complete the fifth anterior sacral foramen.

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[1] Extracted from a D.Sc. thesis submitted by O. S. Heyns to the University of the Witwatersrand and entitled "A Critical Analysis of the Bantu Pelvis, with Special Reference to the Female."

MATERIAL AND METHODS

A 6-piece sacrum has been defined as showing sufficient development of the transverse processes and caudal elements of sacral vertebrae 5 and 6 to complete the fifth anterior sacral foramen. There can be no question of a first coccygeal vertebra being sacralized by virtue of its being merely united with the sacrum in such a manner as to obliterate the normally mobile sacrococcygeal joint.

In order to study the limits of the lateral mass of the fetal sacrum, fetuses were set aside for this purpose only, because the ischiopubic portions of the pelvic girdle had to be removed for the sake of access to the sacrum. Twenty fetuses were used for this sacral problem. Of the 20 fetuses 1 was 16-weeks gestation, 3 had a crown-heel length of 35–40 cm, 12 were 40–45 cm, 2 were 45–50 cm, and 2 were 50–52 cm.

The sacrum was removed with enough of the ilia to determine with accuracy the site of the alae of the first sacral vertebra and the sacro-iliac joint. After the first 8 dissections it was decided to count the lumbar vertebrae, and 12 fetuses were accordingly dealt with more fully. Cleaning the sacrum with scissors, knife, and forceps was done at the time of removal from the body. Special attention was paid to the cleaning of the anterior foramina, the fifth foramen was located, and the nature of the lateral wall determined. Cartilage was readily recognized and in 9 cases confirmed histologically. No attempt was made to study the foramina distal to the fifth.

Difficulty was encountered in preparing the tissue of the lateral wall of the fifth sacral foramen for histological examination. The amount of cartilage present is small, and this is easily lost during preparation. In a few cases muscle tissue remained in the section, but cartilage which had been perceived macroscopically was entirely absent. What happened to this cartilage is not quite clear even now, for attempts were made to dissolve or dehydrate sacral cartilage, but without any success.

Tissues were tied in gauze for the purpose of washing in running water. It is advisable to treat tissues throughout the process in a special section container, the bottom of which is covered with wire gauze.

Fix tissue in formol saline for 12–24 hours.
Wash in running water for 30 minutes.
Then, 15 minutes in each of the following alcohols:
  70%, 90%, 95% Absolute.
Absolute alcohol and chloroform, 30 minutes.
  No. 1 wax — 30 minutes.
  No. 2 wax — 30 minutes.
Cut sections at 10 μ.
Mount section on albuminized slide.
Bake slide in incubator.
Stain with haematoxylin — 10 minutes.
Blue up in running water and counter-stain with eosin for 5 minutes.

RESULTS

Macroscopical cartilage, of which the structure was confirmed histologically in 9 cases, was found present in the lateral wall of the fifth anterior sacral foramen in 19 out of 20 cases. In the exceptional case — one with 6 lumbar vertebrae — cartilage could not be stated to be unequivocally present, though this was probably the case. Statistically the significance of this fetal difference from the adult is such that it must be accepted that in the Bantu fetus the sacrum consists of 6 vertebrae.

In 12 fetuses 10 had 5 lumbar vertebrae, 1 had 6 lumbar vertebrae, and 1 5–6 lumbar vertebrae with a rib on 1 side only. It was in the fetus with 6 lumbar vertebrae that a sixth sacral vertebra could not be established with certainty; but if this fetus had 25 presacral vertebrae, the fifth sacral foramen would be comparable with the sixth of the other columns — and study of these small "sixth foramina" would be very difficult.

DISCUSSION

I. Anatomical

A. Fetal. The 6-piece sacrum found consistently in Bantu fetuses apparently did not occur in European embryos and fetuses. Bardeen ('04) found a sacrum with 6 vertebrae once in 30 embryos (4 lumbar vertebrae twice and 6 lumbar once); Rosenberg (1876) once in 9 embryos (4 lumbar 3 times and 13 thoracic 4 times); Paterson (1893) 5 times in 30 fetuses (6 lumbar 8 times and 4 lumbar not at all); Steinbach (1889) found only 1 variation in 25 fetuses, viz. 6 lumbar vertebrae once, and in 50 infants up to the age of 12 months there were only 3 6-piece sacra — sacralization of coccygeal vertebrae twice and of lumbar once. To these names there must be added those of Kappers ('38), Fehling (1876), Thompson (1899), Falk ('08) and others who have done ontogenetic studies on pelvis and sacrum. For the first group mentioned the figures show that the 5-piece sacrum is the normal, whereas the second group of workers does not even discuss how the lower end of the sacrum is determined nor the number of sacral segments in the fetus. In contrast to this, it has been found in the Bantu fetus the normal sacrum contains 6 vertebrae and that, while variations must be expected to occur, this numerical constitution is probably very constant during the fetal or cartilaginous phase. Paterson (1893) quotes Topinard (1877) as leaning to the view that the normal sacrum contains 6 segments, and that he regards as defective a sacrum possessing only 5 vertebrae.

Because the adult exhibits a 6-piece sacrum in 20 to 30% of cases, and the corresponding figure in the fetus appears to be near 100%, it appears that the cartilage constituting the lateral wall of the fifth foramen is not calcified during the process of ossification of the pars lateralis sacri in more than half of all Bantu fetuses. The question as to the fate of this cartilage now arises. Is it possible for ossifiable cartilage either to disappear or to be converted into fibrous tissue? On this point Bardeen ('10) states: "Not all the cartilage of the embryonic skeleton becomes replaced by bones. Some of the embryonic cartilages become reduced to fibrous tissue, as in the case of the stylohyoid ligament; some give origin to the cartilages of the definitive skeleton, such as the costal cartilages and parts of the nasal capsule; some merely disappear."

It may be presumed that in 20 to 30% of cases the cartilage under discussion ossifies, while in the remainder it becomes the lateral sacro-coccygeal ligament. It is recognized (Keibel and Mall, '10) that in the embryo there are usually 7 coccygeal vertebrae, sometimes 8, this stage being reached in embryos from 8 to 16 mm in length. In the adult the coccygeal vertebrae commonly number 4 or 5, only rarely 6. If coccygeal vertebrae are lost during development, then some elements of the sacrum may similarly disappear. If some mechanism such as Rosenberg's theory (1876) of a proximal pelvic shift is involved, an explanation of these phenomena becomes possible. But the point at issue is simply a question of the possibility of a portion of the sacral cartilage not becoming ossified, and thus supporting the finding for the Bantu that the fetus has a 6-piece and the adult a 5-piece sacrum.

As regards Rosenberg's theory referred to above, statistical analysis has shown this theory to have no foundation in fact (Heyns, '45). If Rosenberg's views concerning the pelvic girdle are correct, then their scope ends with embryonic life, i.e., 2 or 3 months after fertilization of the ovum. If it is possible during early development to make the accurate observations which are a sine qua non for Rosenberg's theory, it must be pointed out that several other observers failed to confirm Rosenberg's findings (Bardeen, '04; Fischel, '06; Stieve, '21 and '23).

B. Adult. It is disconcerting to find in the literature a certain lack of uniformity in determining the numerical constitution of the sacrum. The frequency of fetal variations in lumbar and thoracic vertebrae found by the authors cited above is also unexpected, and conflicts with recent careful work on the adult (Schultz, '30 and '45). Mistakes have unquestionably been made. Thus, in the twenty-second edition of Gray's Anatomy there is depicted (fig. 259) a normal 5-piece sacrum which certainly has the sixth vertebra missing — an inference which is possible because of the half-completed fifth foramina shown. A similar error was made with the Bantu material, e.g. amongst the females 6 4-piece sacra were found giving the unique frequency of 9% (Heyns, '44). In the Basuto male no 4-piece sacrum was found, but in the Zulu male it was seen during preliminary sorting that about 8% of sacra had only 4 segments. Closer inspection led to suspicion and the skeleton boxes were successfully searched for missing lower portions of these sacra and such "5-piece specimens" as the one seen in Gray's Anatomy. It is easy during maceration to lose these small flakes of bone, and even after the third decade of life these vertebrae separate readily from the sacrum.

When a 6-piece sacrum is complete, there can be no confusion in determining the number of its vertebrae. Unless in some skeletal collections the sixth vertebra had frequently become separated from the sacrum — an improbable event — it is difficult to explain why the incidence of 6-piece specimens should be as low as Le Double's (6.1%). Of the authors included by Le Double ('12) the following found an extremely low incidence of 6-piece sacra:

Bianchi	1 out of 130
Steinbach	2 out of 133
Staderini	2 out of 100
Topinard	12 out of 350

These findings can only be accepted with reluctance, though the data showing a high frequency are more readily criticized because of the possibility of counting ankylosed coccygeal vertebrae as sacral. Table 1 shows that the 6-piece sacrum has a percentage incidence of 24.3 in the Bantu, 13.7 in the American Negro, and 21.4 in white stocks. An additional 1809 sacra from different races gave a 6-piece incidence of only 8.8%. If Le Double's groups — i.e. excluding Paterson's (1896) and Bardeen's ('04) — are subtracted from the grand total of over 3,000 sacra, it is seen from the table that 1942 sacra had 6 segments 353 times or 18.2%. It must be conceded at once that there is no justification on statistical grounds for grouping the figures for different series, because the differences between several of the series are significant. In spite of this the tendency for 6-piece sacra to occur about 20 times out of 100 seems to be strongly marked, and the grouping of table 1, even if unjustifiable, can only have the effect of reducing the incidence percentage — presumably below that of the universe.

TABLE 1

Number of sacral vertebrae in human races.

AUTHOR	RACE	NO. OF OBSERVATIONS	NO. OF SACRAL VERTEBRAE			PERCENTAGE OF 6-PIECE SACRA
			4	5	6	
Shore, '30	Bantu	81	0	64	17	21.0
Heyns	Bantu	166	2	121	43	25.9
Total of Bantu		247	2	185	60	24.3
Trotter, '29	Negro	97		90	7	
Schultz, '30	Negro	58		48	10	
Caldwell and Moloy, '33	Negro	159		133	26	
Total of Negroes		314		271	43	13.7
Bardeen, '04	White	53	1	48	4	
Adolphi, '12	White	289	2	225	62	
Frey, '29	White	150	1	117	32	
Trotter, '29	White	92		82	10	
Caldwell and Moloy, '33	White	181		125	56	
Total of Whites		765	4	597	164	21.4
Paterson, 1896	Various races	265	3	218	44	16.6
Radlauer, '08	Various races	351	10	299	42	12.0
Le Double, '12	Various races (including fetuses)	1,193	11	1,109	73	6.1
Total of various races		1,809	24	1,626	159	8.8
Total of all races		3,135	30	2,679	426	13.6
Subtracting Le Double's groups		1,193	11	1,109	73	
		1,942	19	1,570	353	18.2

II. Statistical

The data concerning Bantu sacral vertebrae can be treated statistically as follows:

A. Consider the observation of 20 Bantu fetuses of which at least 19 showed 6 sacral vertebrae.

Let us accept the following hypotheses.

(i) In an indefinitely large "population" of Bantu fetuses a proportion p possesses 6 sacral vertebrae.

(ii) That in random samples of n drawn from this population, the probability p(m) that exactly m of them possess 6 sacral vertebrae is the term containing p^m in the expansion of $(p + q)^n$ where $p + q = 1$. (Technically, m is a statistical variable which has a binomial law of distribution.)

(iii) That the 20 Bantu observations constitute such a random sample.

What information does that one sample afford concerning the value of p, and how can we assess this information objectively? We realize that p *may* have any value between 0 and 1, but common sense suggests that p is nearer 1 than 0. We find ourselves thinking, "if our hypotheses are true and if p is small, say 1/10, then Heyns struck a very unusual sample." Therefore, we doubt that p is really as small as 1/10. By constrast, if $p = 9/10$ we should not be surprised that a random sample of 20 gave the result observed. We regard 9/10 as quite a plausible value of p. Clearly, many plausible values of p exist, and the following mathematical technique merely systematizes the above common sense point of view and helps us to decide which values of p are plausible.

From (ii) $p^{20} + 20p^{19}q$ is the probability of at least 19 observations out of 20 showing 6 sacral vertebrae. Trying various values of p we obtain, for example:

VALUE OF P	CORRESPONDING PROBABILITY OF OBTAINING HEYNS' RESULTS
.95	.664
.7840	.050
.7112	.010
.6225	.001

and as many more as we may care to calculate.

We now argue: p is, and remains, unknown; but the smaller p is the less frequently can we expect to obtain Heyns' results. Thus, for $p < .7840$ we can expect the observed results in less than 1 out of 20 such experiments; for $p < .7112$ we can expect to get the observed results in less than 1 out of 100 such experiments, and so on.

The writer now judges rather confidently that unknown true p is greater than .71. He may be wrong, (a) if one of hypotheses (i), (ii), (iii) is wrong, or (b) if the hypotheses are right but the observations were of a very unusual type. As regards (a) we have not got enough data to test the hypotheses, but we are at least employing standard hypotheses which have proved satisfactory for similar data. As regards (b), the writer is taking as it were a risk of 1 in a hundred of being wrong. If he consistently makes judgments according to the above technique he can expect about 99 in 100 such judgments to be right. The reader need not accept the above judgment. He may, for example, be willing to take a risk of one in 20 of being wrong, and judge that true p is greater than .78. In any case, here is an objective technique for making such judgments, and with each judgment we can, as it were, associate a numerical measure of the confidence we have in it.

B. Consider the data given for adult Bantu by Shore ('30) and Heyns (table 1). Suppose we accept hypotheses similar to those employed in A, viz.

(i) In an indefinitely large population of Bantu adults a proportion p possesses 6 sacral vertebrae.

(ii) That in random samples of n drawn from this population the probability, $p(m)$, that exactly m possess 6 sacral vertebrae is the term containing p^m in the expansion of $(p + q)^n$ where $p + q = 1$.

(iii) That Shore's data and Heyns' data are both random samples from the same population. (The writer can suggest no reason for doubting this).

If (iii) holds then we are entitled to amalgamate the 2 samples and are left with the problem of estimating p from a sample of $n = 247$ cases in which $m = 60$ showed 6 sacral vertebrae.

Here n is so large that we can safely employ the well known mathematical approximation that

$$z = \frac{m/n - p}{\sqrt{\frac{pq}{n}}}$$

is normally distributed with zero mean and unit standard deviation. One property of this distribution is that the probability that z is greater than $+ 2.58$ or less than $- 2.58$ is .01. We can use this to estimate p, given $m/n = 60/247$ as follows.

$$\text{Putting } z = \frac{60/247 - p}{\sqrt{\frac{pq}{247}}} = \pm 2.58$$

and solving for p, the solutions are p = .320 and p = .180. If p is greater than .320 or less than .180, then z, with m/n = 60/247, is less than − 2.58 or greater than + 2.58. This means that if p lies in the domain just mentioned, then our observed ratio, 60/247, was an unusual observation, of a type which occurs less than once in a hundred such experiments. Hence we can judge that p lies *between* .180 and .320 taking as it were a risk of 1 in 100 of being wrong. In essence this is exactly the same type of argument as used in the previous case, and it can be as readily modified. For example, if we are prepared to take a risk of 1 in 20 of being wrong, replace 2.58 by 1.96 in the above calculations, and the corresponding limits for p are .194 and .300. The writer suggests that the analyses A and B show fairly conclusively that p for fetuses and p for adults differ widely in value and that we have a fair idea as to where the 2 values lie. The treatment given here is by no means exhaustive, but it was judged preferable to try to do enough for the purpose in hand with a certain amount of explanation of the statistical arguments employed rather than give a thorough treatment with no such explanation. Readers who wish for a fuller treatment of the mathematical theory should consult any good standard work such as "An Introduction to the Theory of Statistics" by Yule and Kendall ('40).

SUMMARY

1. The number of vertebrae constituting the fetal sacrum has been studied in 20 Bantu (South African Negro) fetuses. In 19 fetuses the sacra contained 6 vertebrae each, and in 1 the sacrum was probably 6-piece. Histological confirmation of the cartilaginous nature of the lateral wall of fifth sacral foramina was obtained.

2. The fate of the cartilaginous lateral mass of the sacrum is discussed, and the conclusion arrived at that in about 80% of individuals the cartilage of the fifth sacral foramen becomes the lateral sacro-coccygeal ligament, but that in the remainder the cartilage ossifies producing, as a result, the 6-piece sacrum. Consideration is given to the role of this mechanism, known to occur only in the Bantu but probably present in other races, in the production of the variable incidence of the 6-piece sacrum in series reported from different regions.

3. The statistical problem presented by observations on a small series of 20 was sufficiently significant to justify the

introduction of a note by a mathematician who has discussed the statistical aspect of the investigation, and agrees with the conclusion that the fetal sacrum in the Bantu contains 6 vertebrae.

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Hormones and Evolution.— There is one major difference of a negative kind between us and the rest of the zoological group to which we belong . . . It is our freedom from the rigorous internal chemical control of reproductive functions such as is experienced by apes and monkeys and even more so by other mammals. Recent research into the physiology and chemistry of the hormones which control reproduction — the hormones of the anterior lobe of the pituitary gland, and the steroid hormones of the gonads — shows that this freedom must have been vital to our emergence as *Homo sapiens* . . .

The association of human evolution with the abolition of a clockwork reproductive system finds us today in possession of a system which, quite apart from the fact that it can be very easily checked by individuals anxious not to breed, not uncommonly breaks down physiologically.

The general problem is . . . so important that the possibility that physiological factors do help in producing todays widespread picture of sterility urgently requires investigation.— S. Zuckerman. The influence of hormones on man's social evolution. Endeavour, vol. 3, no. 10, 1944, pp. 80–83.

ON THE INCIDENCE OF THE FORAMEN OF CIVININI AND THE PORUS CROTAPHITICO-BUCCINATORIUS IN AMERICAN WHITES AND NEGROES

II. OBSERVATIONS ON 2745 ADDITIONAL SKULLS [1]

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TWO FIGURES

The skulls used in this study are in the T. Wingate Todd collection of the Hamann Museum, Department of Anatomy, Western Reserve University, Cleveland. To Dr. N. L. Hoerr, Professor of Anatomy, I am indebted for permission to examine them, and to Mr. William H. Sassaman, curator of the museum, for constant interest and cooperation.

The description of the pterygo-spinous foramen of Civinini and the pterygo-alar foramen (Porus crotaphitico-buccinatorius of Hyrtl) was given in a previous communication (Chouké, '46).

Altogether 2745 skulls, consisting of 1595 White skulls (1396 male and 199 female), 1074 Negro skulls (822 male and 252 female), and 76 skulls of unknown race or sex, were studied. The age varied from 16 to 93 years. The pterygo-spinous foramen of Civinini was found to be present 150 times, or in 5.46%. The pterygo-alar foramen (porus crotaphitico-buccinatorius of Hyrtl) was present 163 times, or in 5.94% of the same collection.

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THE PTERYGO-SPINOUS FORAMEN (CIVININI)

The pterygo-spinous foramen was present four times as often in the skulls of the White males of this series as in the skulls of the Negro males, 8.38% and 1.95% respectively. In the females this ratio was only about 2 to 1 or 3.01% and 1.59% respectively. The combined ratio of the foramen in all Whites, males and females, to all Negroes, males and females, is 7.71% to 1.86%. It is interesting to note that the pterygo-spinous foramen of Civinini was present in the Negro skulls of this series in 1.86% of cases as compared to 3.48% in the Terry collection. In the White skulls of this series it was present in 7.71% of cases against 12.76% in the St. Louis series. Data for the presence of this foramen as to stock, sex, and side are presented in table 1.

TABLE 1

Foramen of Civinini.

NEGROES	SIDE	NO.	%	TOTAL %	WHITES	%	TOTAL %	TOTAL NOS.	%	TOTAL %
Males	Right	8	0.97		33	2.36		41	1.85	
	Left	4	0.49		52	3.72		56	2.52	
	Bilateral	2	0.24	1.95	16	1.15	8.38	18	0.81	6.00
Females	Right	1	0.40		2	1.01		3	0.67	
	Left	1	0.40		2	1.01		3	0.67	
	Bilateral	1	0.40	1.59	1	0.50	3.01	2	0.44	2.22
Total	Right	9	0.84		35	2.19		44	1.65	
	Left	5	0.47		54	3.39		59	2.21	
	Bilateral	3	0.28	1.86	17	1.07	7.71	20	0.75	5.36
No record available	Right	1	1.32					45	1.64	
	Left	2	2.63					61	2.22	
	Bilateral	2	2.63	9.21				22	0.80	5.46

The percentage of the presence of the pterygo-spinous foramen in this series of 2745 skulls is slightly lower in the White and Negro male skulls, considerably lower in the White female skulls, but slightly higher in the Negro female skulls than in the previously reported series of 1544 skulls from the Terry collection in St. Louis. Again the percentage is slightly lower than in the St. Louis collection in all Whites and in all Negroes.

THE PTERYGO-ALAR FORAMEN

The pterygo-alar foramen (porus crotaphitico-buccinatorius of Hyrtl) was found almost four times as often in the Negro skulls as in the White skulls in this series, as compared to only twice as often in the St. Louis series. The ratio for the males as well as for the females was also 4 to 1; this compares with 2 to 1 in the St. Louis series. It is noteworthy that this foramen was present in the Negro skulls of this series a little less than two-thirds as often as in the St. Louis skulls; and in the White skulls of this series a little less than one-third as often as in the St. Louis series. Table 2 reveals the data for the presence of the pterygo-alar foramen according to race, side, and sex.

TABLE 2

Pterygo-alar foramen (Porus crotaphitico-buccinatorius).

NEGROES	SIDE	NO.	%	TOTAL %	WHITES	%	TOTAL %	TOTAL NOS.	%	TOTAL %
Males	Right	30	3.65		14	1.00		44	1.98	
	Left	40	4.87		20	1.43		60	2.71	
	Bilateral	15	1.82	12.17	3	0.21	2.87	18	0.81	6.31
Females	Right	7	2.78		0	0		7	1.55	
	Left	5	1.98		3	1.51		8	1.77	
	Bilateral	4	1.59	7.94	0	0	1.51	4	0.89	5.10
Total	Right	37	3.45		14	0.88		51	1.91	
	Left	45	4.19		23	1.44		68	2.55	
	Bilateral	19	1.77	11.17	3	0.19	2.70	22	0.82	6.11
No record available	Right	0	0					51	1.86	
	Left	0	0					68	2.48	
	Bilateral	0	0					22	0.80	5.94

The youngest skulls in which the pterygo-spinous foramen (Civinini) was found, were a White male skull, 21 years, and a 25-year-old White female skull. The oldest skull showing the foramen of Civinini was that of an 86-year-old White female.

The youngest skull showing the pterygo-alar foramen (porus crotaphitico-buccinatorius of Hyrtl) in the Negro was a male 21 years, in the White a male of 24. The oldest in the Negro was a male of 88 and in the White a male of 88.

The age does not seem to bear any relationship to the presence or absence of these two anomalies.

In addition to the presence of a complete pterygo-spinous foramen, some skulls show an incomplete foramen on one or both sides. In other words, the beginning of this foramen is definitely indicated. Table 3 presents the data for such indications.

TABLE 3

Foramen of Civinini incomplete.

NEGROES	SIDE	NO.	%	TOTAL %	WHITES	%	TOTAL %	TOTAL NOS.	%	TOTAL %
Males	Right	44	5.35		158	11.32		202	9.11	
	Left	35	4.26		163	11.68		198	8.93	
	Bilateral	16	1.95	13.50	113	8.09	37.03	129	5.82	29.67
Females	Right	13	5.16		21	10.55		34	7.54	
	Left	8	3.17		24	12.06		32	7.10	
	Bilateral	8	3.17	14.68	15	7.54	37.69	23	5.10	24.83
Total	Right	57	5.31		179	11.22		236	8.84	
	Left	43	4.00		187	11.72		230	8.62	
	Bilateral	24	2.23	13.78	128	8.03	39.00	152	5.70	28.85
No record available	Right	8	10.53					244	8.89	
	Left	4	5.26					234	8.52	
	Bilateral	3	3.95	23.68				155	5.65	28.71

In the same way the beginning of the pterygo-alar foramen is also indicated in about 18% of cases, as seen in table 4.

These skulls may be considered to have potential foramina which might or might not have been completed had the individual lived longer.

Jones' ('31) statement that: " In 8% an attempt at the completion of a pterygo-spinous bar was present; this occurred equally frequently on the right and left sides but in no case was bilateral" is only partially confirmed by the observations of this series of skulls. The "attempt at the completion" of a pterygo-spinous bar occurred almost with equal frequency on the right and left sides to a total of about 9% in all skulls. In Whites about 11.5%, in Negroes about 5%. This attempt at completion was also present bilaterally in about 6% of all

TABLE 4

Pterygo-alar foramen (Porus) incomplete.

NEGROES	SIDE	NO.	%	TOTAL %	WHITES	%	TOTAL %	TOTAL NOS.	%	TOTAL %
Males	Right	97	11.80		65	4.66		162	7.30	
	Left	65	7.91		57	4.08		122	5.50	
	Bilateral	39	4.74	29.20	20	1.43	11.60	59	2.66	18.12
Females	Right	22	8.73		5	2.51		27	5.99	
	Left	17	6.75		2	1.01		19	4.21	
	Bilateral	12	4.76	25.00	1	0.50	4.52	13	2.88	15.96
Total	Right	119	11.08		70	4.39		189	7.08	
	Left	82	7.64		59	3.70		141	5.28	
	Bilateral	51	4.75	28.21	21	1.32	10.72	72	2.70	17.76
No record available	Right	3	3.95					192	6.99	
	Left	6	7.89					147	5.36	
	Bilateral	2	2.63	17.11				74	2.70	17.74

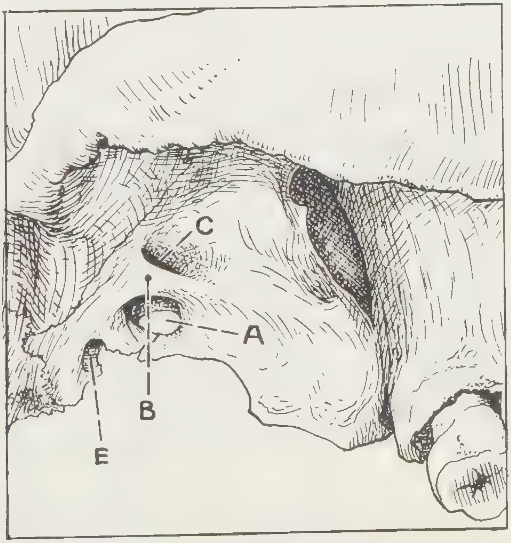

Fig. 1 No. 1176 R, right side

A. Pterygo-spinous foramen of Civinini.

B. Heavy bony bar completing the pterygo-alar foramen (Porus crotaphitico-buccinatorius of Hyrtl) C.

E. Incomplete foramen spinosum.

Note that the axis of the pterygo-alar foramen is horizontal while that of the foramen of Civinini is vertical. The foramen ovale is not visible, being covered by a bony bar (B).

skulls, which is at variance with the skulls examined by Jones ('31). Possibly the larger number of skulls examined by the present writer may explain the difference. Perhaps there might be a racial difference.

It should be emphasized again that the axis of the pterygo-spinous foramen (Civinini) is almost at right angles to the axis of pterygo-alar foramen (porus crotaphitico-buccinatorius of Hyrtl) and they both may be present on the same side of one skull simultaneously (fig. 1).

The pterygo-spinous foramen may be divided into several parts completely or partially by the presence of bony spicules (fig. 2).

A discernible shallow but broad sulcus is present in about 60% of skulls, in that portion of the base of the great wing of the sphenoid which lies in front of the foramen ovale and lateral to the base of the pterygoid process. In the recent

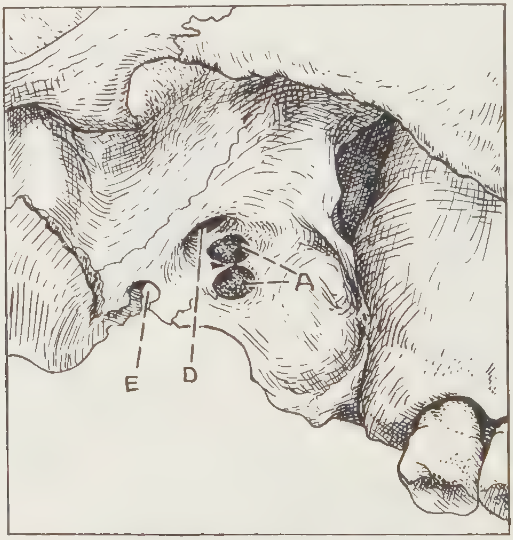

Fig. 2 No. 2914 R, right side

A. Pterygo-spinous foramen of Civinini, divided into three parts by two bony spicules.

D. Foramen ovale.

E. Incomplete foramen spinosum.

state the nervus crotaphitico-buccinatorius lies in this sulcus, before its division into temporal and buccinator branches.

About 25 or 30% of skulls show the spine of Civinini, either on the right or the left side or bilaterally. This spine is quite prominent, projecting backwards from about the middle of the lateral pterygoid lamina, and gives attachment to the pterygo-spinous ligament. The ossification of this ligament into a bony bar completes the pterygo-spinous foramen of Civinini.

SUMMARY

The pterygo-spinous foramen (Civinini) was found four times as often in all Whites as in all Negroes. In the White females it was present only twice as often as in the Negro females.

In general in these 2475 skulls, 1595 Whites (1396 males and 199 females), 1074 Negroes (822 males and 252 females), seventy-six unknown race and sex, the incidence of pterygo-spinous foramen is slightly lower in the White and Negro male skulls, considerably lower in the White females, but slightly higher in the Negro females than in 1544 previously reported skulls. This foramen was found 150 times or 5.46% in the present series of 2745 skulls.

The pterygo-alar foramen (porus crotaphitico-buccinatorius of Hyrtl) was found four times as often in the Negroes as in the Whites of this series as compared to only twice as often in the previously reported series. The incidence of this foramen is slightly lower in the Negroes, considerably lower in the Whites of this series as compared to the first series of skulls.

Observations on this series include the cases in which the beginning of the pterygo-spinous foramen and that of the pterygo-alar foramen is definitely indicated. Similar observations were not carried out in the first series.

Unlike the series of skulls observed by F. Wood Jones ('31) bilateral pterygo-spinous foramena were definitely indicated in 5.70% of cases in the present series.

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JONES, F. WOOD 1931 The non-metrical morphological characters of the skull as criteria for racial diagnosis. Part II. The non-metrical morphological characters of the Hawaiian skull. J. Anat., *65:* 368–378.

WHITE-NEGRO INTERMIXTURE IN BRITAIN.— Some 220 children [examined at Cardiff, Hull and Liverpool] resulting mainly from the mixture of Negro men and European women have been analyzed and compared — so far as the nature of the data permits — with similar records for a sample of ''English'' children of approximately the same ages. Twenty quantitative characters, including four in which there is usually a wide difference between the parental stocks involved in this type of racial mixture, were used as a basis for the comparison. Excluding the four latter characters, the ''hybrid'' children appear to differ mainly from the ''English'' children in being longer in the face, heavier in weight, and in possessing a greater width between the eyes. In the differentiating characters — viz., nasal breadth, distance from crease to tip of nose, thickness of lips, and ratio of nasal breadth to nasal height — the ''hybrids'' are found to be approximately intermediate between the ''English'' (White) children and a ''hypothetical'' Negro group. The latter remarks apply also to skin colour. In hair and eye colour, however, the ''hybrid'' children were obviously characterized more by darker than by lighter shades of pigmentation, thus showing a closer approach to the Negro parental group. So far as any value can be attached to estimations of variability of the cephalic index, there was no disparity between the samples. Speaking generally again, the ''hybrids'' showed a slight tendency towards greater size and development compared with the ''English'' children, especially the girls. Finally, dental caries was found less frequently among the Anglo-Negro children in general than among the White children.— K. L. Little. Some anthropological characteristics of Anglo-Negro children; an aspect of racial mixture in Britain. J. Roy. Anthrop. Inst. Gr. Brit. and Ire., vol. 73, 1943, pts. 1 and 2, pp. 57–73 (published in 1946).

REVIEWS

UP FROM THE APE. By EARNEST ALBERT HOOTON. Revised Edition, xxii + 788. The Macmillan Company, New York, 1946.

I knew this book was intended not only for information and instruction but also for enjoyment and stimulation, so I took it home on the streetcar and while brachiating precariously from a strap I began reading by chance: "When I travel in the subway, I often look at ears. I once knew a girl who was very beautiful excepting her ears. They were long, flaccid, fish-belly white appendages, which looked more like bleached oysters than shells. If that girl has any children, I hope they have not inherited her ears." I enjoyed this and was stimulated to look in the crowded car at girls' ears for a change. Then I began reading again and, as it happened, about Bruno Bloch and others attempting "to ferret out the processes of melanogenesis as it occurs in the body, concentrated upon the second stage of the oxidation of tyrosine into dihydroxyphenylalanine . . ." At this point I mercifully got a seat and was able to start properly with the preface where it says: "This book does not presuppose on the part of the reader any knowledge of geology, biology, anatomy, or anthropology." My initial fear was not dispelled, that at least a thorough familiarity with modern chemistry is taken for granted and that, hence, I am really not qualified as reviewer, no matter how greatly I admire Professor Hooton's courageous effort to tell in one readable volume the vast and complex story of man's evolution.

Up from the Ape contains much more than this title implies. It leads the reader also up to the ape and shows in detail what men are like now that they have come up. For the new edition, which embraces nearly all of modern physical anthropology and includes even somatotyping and anthropometry, the title has become inadequate. But it does suggest, and rightly, that the book is not dull and that it is technical only as far as it has to be. In the 15 years between the old and new editions of this book, physical anthropology has made great advances, a bewildering wealth of fossil material has accumulated and modern methods from other sciences have become adapted for new attacks on old problems. The second edition reflects this healthy growth of the science of man by having been largely rewritten and several new sections added. As compared to the first edition, the new one contains 166 additional pages with more words per page, but its thickness has shrunk from 40 to 34 mm. The parts dealing with *Fossil Ancestors* and with *Heredity and Race* have been most extensively revised to bring them up-to-date, an entirely new part has been inserted on the *Anthropology of the Individual* and an appendix has been added on *Elementary Anthropometry.* Such topics as human genetics, blood groups, dermatoglyphics, and, particularly, body build and its relation to temperament, behavior and disease, receive far more attention in this new than in the old volume. There are chapters devoted to *Racial Pathology, Racial Differences in Response to Drugs,* and *Physiological Tests of Race,* though there is little on anatomical race differences besides, of course, those relating to skeleton, teeth, skin, hair and eyes. The general comment on primary and secondary human races, race classification, etc. has been much expanded and is far sounder and saner than most of that recent flood of more or less biased or tendential articles and books on *The Race Problem* by other authors.

As had been expected and hoped for, the new edition has retained the lively, informal style of the original version and contributes many new and delightful anecdotes, wisecracks and poems. The only exception is formed by the chapter on constitutional anthropology which is a serious technical outline of the aims and accomplishments of the most active students of human constitution. It contains rather bitter denunciations of all who do not share the author's unbounded faith in constitution work and his firm belief in the value of the results achieved so far.

The bulk of the book and its most valuable contribution consists of the 2 large sections on fossil ancestors and on human races which present splendid, authoritative and comprehensive accounts of man's comparatively recent changes and differentiations. A last-minute addendum deals with the "Gigantic-jawed Javanese" and with "Gigantopithecus, the Hong Kong Drugstore Giant." In contrast to the just-mentioned, well-balanced sections, the first 3 parts on *Man's Relations,* the *Primate Life Cycle* and the *Individual Life Cycle,* though equally readable, appear to be somewhat uneven, incomplete and, at times, unduly simplified. The discussions relating to elementary comparative-anatomical and embryological facts and theories are not always in accord with our knowledge of today and might have been left out entirely as subjects readily available in numerous other recent books. In his *Life Cycles* the author has brought together a great wealth of scattered information and has presented many original ideas, often well-founded, sometimes plausible and occasionally hardly tenable. Here he has stimulated the student to search for more information and has challenged his colleagues to fill the obvious gaps in these chapters and to prove or disprove some of the novel claims and interpretations of facts. As a devoted teacher, the author seems to feel that, after having described the many and diversified evolutionary specializations among primates and the profound bodily adaptations of man, he must offer reasons and simple explanations for these changes. It would be most gratifying if all these ready explanations were convincing and final, so that we could turn to the many remaining and entirely unsolved problems. But Professor Hooton's reasoning in this connection is not infrequently quite teleological and overlooks many an exception which spoils the rule. He, as so many of us, lapses readily into Lamarckian arguments by implying that changed habits are the cause, instead of the effect, of changed forms. To enumerate and discuss the specific statements appertaining to evolutionary changes in primate morphology which are open to question, is obviously quite impossible in a brief review. The following random samples must suffice to illustrate the kind of problem which keeps the investigator up at night, but delights the teacher intent upon revealing to his eager students how simple are the ways of nature: Among the few "principal modifications in the human direction that took place in the common ancestors of man and the great apes at the gibbonoid stage of evolution before the development of giant primates" Professor Hooton lists "the assumption of an erect-sitting posture as the habitual position of the animal at rest" and "the skull to be poised on the vertebral column from a basal articulation rather than suspended from an occipital articulation." The reviewer can here merely assert briefly and bluntly that in his experience there is no generally valid, essential difference between lower and higher simian primates in regard to the habitual positions at rest nor in regard to the relative positions of the cranio-vertebral articulations. There is little use, however, in finding fault with the writings of Professor Hooton who can charm and disarm any critic on every page. Does he not say himself: "The hands manipulate objects, fashion tools, and use them; the jaws recede, the brain grows, and man begins to think. But handling things does not necessarily produce thought, nor do tools make the brain grow. Not every treelorn ape blunders into intellectuality. These pseudo-philosophical ruminations are merely intended as a warning to the reader against facile mechanistic interpretations of observed or deduced evolutionary changes. He must be on his guard against those who readily evolve an entirely new species out of a new habit."

In a brand-new chapter on *Were Man's Ancestors Arboreal Arm-Swingers or Pronograde Ground Apes?* Professor Hooton gives a fair presentation of part of the arguments for both hypotheses and concludes: ''To me, the most reasonable solution of the problem, as the evidence now stands, lies in a compromise between the two extreme views.'' Immediately following one reads: ''Indubitably, the earliest ancestor of man at the ape stage, when the common anthropoid-humanoid stock had already topped the Old World monkey level, was some kind of an arboreal ape not yet of modern giant primate size.'' Further on it is stated: ''There can be little doubt that this prehuman arboreal ape sat up habitually and climbed tree trunks with the long axis of the body perpendicular to the ground or vertical. If the fixation of the viscera by suspension from the head end was acquired in arboreal life, which I think is very probable, if not certain, our ancestor might well have acquired these modifications without having previously become a confirmed brachiator.'' In the final summary of man's rise up from the ape some ''first tiny, unspecialized anthropoid ape'' is assigned to the lower Oligocene. This is succeeded in the lower Miocene by ''first generalized giant apes, not strictly specialized for arboreal life, combining in dental, mandibular, and pedal characters resemblances to chimpanzee, orang, gorilla, man.'' Just as I read this a squirrel ran perpendicularly up a tree outside my window and sat bolt-upright on a branch. Will that habit change its form or has its form led to the habit? That, however, worries me less than that versatile ''first giant ape'' which, in its teeth, lower jaw and feet, combines and resembles the characters of chimpanzee, orang, gorilla, and man. Is he not hard to conceive? I am also puzzled by that special head end suspension of viscera in upright animals which seems to have originated in 1912 in a publication by Keith as some kind of literary mutation with, one should have thought, poor survival value. These quotations and remarks must suffice to indicate that, no matter how brilliantly and completely one tells the story of man's coming up, one still has to draw largely on one's imagination and this in the explanatory part even more than in the descriptive one. The question arises: Are we prepared today fully to reconstruct and account for man's past? The answer depends partly on one's temperament — and that supposedly on body build.

The end of the book remains to be mentioned. The bibliography, though listing most the works used in the text and more than twice as large as in the first edition, omits many important titles for which the student would have been grateful. Some references on up-to-date embryologies, comparative-anatomies, etc. are specially missed inasmuch as these sciences are dealt with in the book. Ruch's *Bibliographia Primatologica*, the greatest gift to primatology, should certainly be included, and also Clark's splendid book on *Early Forerunners of Man*, especially since the reader is referred to Sonntag's old and inadequate *Morphology and Evolution of Apes and Man.*

The appendix on anthropometry is "intended for students who wish to acquaint themselves with the rudiments of laboratory procedure in the study of the human skeleton and with the basic measurements and observations taken upon living subjects." This outline for beginners, as far as it goes, is superior to anything else, available in English, yet it is somewhat disappointing in regard to the puzzling selection of the topics presented. For instance, the lumbar and sacral vertebrae are assigned nearly one page full of instructions, but there is not one word about other vertebrae. Pelvis and scapula receive detailed attention, presupposing good anatomical knowledge, yet the clavicle and the sternum are never mentioned. "Arm length," that meaningless measurement "span," and "biacromial diameter" (why not simply shoulder breadth?) are discussed at length, but anything appertaining to the lower limbs seems to be taboo in Cambridge, at least for youngsters. The technique for taking the bigonial diameter is described and illustrated, but hands and feet are ignored.

The number of illustrations has been considerably increased in the new edition. Most of them are excellent or, at least useful, but the full-page photograph of a spider monkey is that of a half-starved infant, the stuffed tarsier on plate 1 shows little resemblance to a live specimen, and some of the camera lucida drawings of fossil skulls are very much distorted.

The entire book, though indicating future trends in physical anthropology, has nothing to say about the future of man himself. That seems regrettable in such a comprehensive work which has already inspired one reader to commit the following semi-poetic forecast, supposedly projecting the trends of man's past rise into the future.

The future of man is bright
If reason replaces might
  And *sapiens* really thinks
  While in teeth and jaws he shrinks.
His late-found brow will rise,
His shrunken toes lose size,
  His rate of growth be slower,
  His planned birth-rate get lower.
His eyesight brings misgiving.
He neglects the art of living,
  But he betters his standard of life.
  Selecting his food and his wife
With less taste, but more reasons
From each clime, in all seasons,
  Changing habits more than shape,
  Moving further up from the ape.

A. H. SCHULTZ

HUMAN GENETICS. By REGINALD RUGGLES GATES. The Macmillan Company, New York, 2 volumes, xvi + 742, vi + 743–1518 pp. 1946 ($15.00 set).

Genetics, aside from physiology, has been the most active field of biological research during the 20th Century. This activity has led to elaboration of a rigorous conceptual scheme, The Chromosome Theory of Heredity. The fundamental nature of modern genetical concepts is indicated by the fact that, within the fields of experimental biology, the conceptual systems of only general genetics and general physiology (including biochemistry) are applicable both to plant and animal phenomena. The scientific attractiveness of modern formal genetics lies in the double consideration that its phenomena may be expressed in mathematical terms, and they may, so to speak, actually be "observed" in the working chromosomal apparatus of the dividing cell.

From the standpoint of theoretical structure, the special field of human genetics is relatively advanced. Professor Gates, in the present revision and expansion of his *Heredity in Man* (1929), has suggested the extent to which this special theoretical system has been successfully interpreted in terms of empirical data. In so doing, his ". . . approach has been biological rather than more strictly genetical throughout (1: v)." Considering theoretical possibilities, and in contrast with general genetics, empirical knowledge of human genetics is in an early developmental stage. Of particular pertinence to the contemporary situation in empirical human genetics is Szent-Györgi's dictum (1940) on the characteristic coexistence of wonderful success and profound ignorance in present-day biology.

The volumes are definitely and grandly entitled *Human Genetics.* On this ground they are subject to criticism. That title connotes an imposing corpus of systematically integrated biological knowledge with high validity of demonstration. It connotes a status associated with *Drosophila* genetics, the genetics of *Zea mays,* or less grandly, the genetics of the mouse. But, in the present work, Professor Gates has re-searched comparatively little that is modern genetics. Rather he has provided an excellent reference catalogue of human characteristics which apparently (in many cases definitely) "Mendelize." His text little reflects that the *conceptual-methodological* position of human formal genetics — a position attained largely through the work of Bernstein, Cotterman, Finney, Fischer, Hardy, Haldane, Hogben, Lenz, Macklin, Penrose, Snyder, Weinberg, Wiener, Wright and others — is considerably in advance of collection and analysis of material in terms of that methodology and theory. It is this more developed part of human genetics (where the situation in general genetics is the criterion for advancement) that Professor Gates has neglected or underplayed.

In man, full demonstration of genetic regularities is usually provided by mathematical analysis of pooled family or population data. Lacking such treatment, one has no means of reliably judging even such simple statements as "characters X and X′ are determined by single alleles A and a," or "variables Y^1, Y^2, Y^3, Y^4 are determined by multiple alleles T, t', t." A general shortcoming of the book, then, is that criteria for assessing arguments are not uniformly presented. For example, Professor Gates does not make it sufficiently clear that "the MN hemagglutinogens are determined by single alleles with complete penetrance and constant expressivity" is a statement with high validity of demonstration, whereas "sinistral occipital hair whorl is determined by a single allele with dominance" is a statement of low validity.

Actually, if recognized, such shortcomings detract but little from the usefulness of the Gates encyclopaedia. For physical anthropology, the 10 chapters on general principles, cytology, linkage, eye and hair color, blood groups, twins, normal mental differences, constitution, stature and size, and "anthropological characters" are of first importance. In addition, extensive material in the remaining 21 chapters, which emphasize medical genetics, is pertinent to some anthropological problems.

A full listing of textual errors and seeming misconceptions regarding details is not appropriate here. However, certain misinterpretations of general relevance should be mentioned. Of these perhaps 2 are of most consequence: (1) A common confusion between the *correlation* of phenotypical traits and the *linkage* of genes determining those traits is perpetuated. Linkage refers to the physical location of 2 or more genes in a specific chromosome pair. Linkage in man cannot be demonstrated by simple correlation techniques; special mathematical treatment is required. The distribution of phenotypes determined by linked genes does *not* necessarily show correlation in a population. Thus far, no valid case of autosomal linkage in man has been reported (contrast table 4, p. 83 *et passim*). (2) Statements contrary to the basic theory of genetic equilibria appear. For instance, in an ideally large population with genes for the M and N agglutinogens in equilibrium, where neither p nor q take values close to 0 or 1, p and q may take any values consistent with $p^2 + 2pq + q^2 = 1$, rather than being limited to the ratio 25% M : 50% MN : 25% N (see p. 698).

Some other misinterpretations are of general importance: table 1 (p. 23) is neither complete nor fully correct; sex chromosomal inheritance rather than sex-linkage takes various forms (p. 26); "sex-influenced'' is not commonly taken as synonymous with ''sex-limited'' (p. 27, text and fn.); it *is* a plausible guess that man and the gorilla have more genes in common than unlike genes (p. 43); ''hybrid vigor'' refers to a phenomenon, ''heterosis'' to one explanation (probably the best available) of that phenomenon (p. 45); Andres and Navashin ('35, '36) consider their chromosome number 9 to be an autosome, not the X (p. 57); the evidence for racial differences in chromosomal length is not trustworthy (pp. 57–58); the classes used in determining Wiener's Q-statistic are misquoted (p. 70); Bernstein's $\mu\nu$-statistic is available for ''indirect'' as well as ''direct'' ascertainment (p. 71); Levit ('35, '36) considers only 11 rather than 30 known genes to be sex-linked (p. 75); if chiasmata occur in both arms of the homologous portions of the sex chromosomes (p. 77), then the centromere in figure 23 (p. 81) is mislocated; the 3 cytological regions of the sex chromosomes are not consistently recognized (table 4, *et passim*).

Human genetics suffers from lack of adequate bibliography. Probably over 20,000 works contain original data or methodology directly pertinent to the subject. Gates has listed nearly 5600 entries in the pages of ''Literature'' which terminate each of the 31 chapters. These constitute the best published bibliography now available. A minority of these contain no data on man, being quoted for their pertinence by analogy from other organisms. Unfortunately, certain references made in the text are not listed in the appropriate chapter ''Literature;'' in some cases it is difficult, if not impossible, to find the correct title and reference. The same method of citation but with the literature assembled in a single list would be more advantageous. An index (89 pages) provides an excellent working guide to the characters, a good guide to the literature, discussed in the text. These tools contribute greatly to the value of the volumes for reference.

Regarding Professor Gates' discussion of serology, developments since the closing of his manuscript are worthy of note. Discovery in England of the 3 ''new'' Lutheran, Levay, and Kell antigens (independent of the ABO, MN, P, and Rh systems) and a ''new'' Willis allele in the Rh series, provides a theoretical possibility of distinguishing, on the basis of known serological reactions, over 100,000 combinations of different blood groups. These developments are of prime significance for the future of a genetic anthropology.

Notwithstanding certain difficulties which are perhaps inherent in the initial printing of a work of large magnitude, Professor Gates and the Macmillan Company are to be congratulated on producing a much needed encyclopaedic reference catalogue of human heredity.

J. N. SPUHLER
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MARCELLIN BOULE'S LES HOMMES FOSSILES. ÉLÉMENTS DE PALÉONTOLOGIE HUMAINE. Troisième édition par HENRI V. VALLOIS. Paris, Masson et Cie, 1946. xii + 587 pp., 294 figures. (1200 francs.)

Marcellin Boule's famous book, the second and latest edition of which was in 1923, has just appeared in a new edition. Much has changed since 1923. The 2 decades between these bibliographical events brought important discoveries of fossil human forms from almost everywhere in the world. They have profoundly altered the traditional picture of fossil man, as it was established by the anthropologists of the first quarter of this century. More than that. Marcellin Boule, the author, did not see the new edition. He tried to work on it during the war, but passed away (July 4, 1942) before he could finish his task. Henry V. Vallois, the ablest man who could be found, took over. Not an easy job. Boule was very categorical, and Vallois has to respect it. In the reviewer's opinion he did this to a greater extent than tact and facts justify. In more than one instance, one has the impression that Vallois' judgments might have been somewhat different if he could have gone his own way.

The external appearance of the book remains the same. The paleontological and archeological data are reported with perfect knowledge, completeness and accuracy. For the first time we have a first-hand review of the late paleolithic finds of Africa studied by French scientists. The description of all this new material makes the volume larger than the second edition by more than 100 pages and 50 figures.

What the reviewer deplores is the retention of Boule's inconsistency in the arrangement of the contents, and Boule-Vallois' general interpretations. The arrangement follows first the morphological line: actual primates and fossil apes come first, then the prehominids, *Pithecanthropus* and *Sinanthropus;* after this, the fossils are taken up according to the geological line. But this holds good only for the finds on European soil; those from outside Europe are arranged after the geographical principle. Such a proceeding tears apart what should have been kept joined, not only for didactical reasons. Regarding his interpretations, Vallois did not get rid of his predecessor's prejudices, which were excusable in a man who had grown up with them. This again has led to inconsistencies. For instance: in the preface, Vallois refers to the fossil men of Mt. Carmel and Kafzeh as "forms intermediary between Neanderthal man and *Homo sapiens,* bringing finally those stages of transition which one has searched for in vain over our [European] continent." Furthermore, "Solo man shows us, in Java, types intermediary between the classic Neanderthal man and *Pithe-*

canthropus" (page vi). But in the text Neanderthal man is referred to as "a particular kind, the terminal flower of a bough, faded and withered today, of the hominid branch" (page 550), and *Pithecanthropus* is characterized as "an extinct side-branch of the hominid branch" (page 107). It is difficult to reconcile these statements, apparently contradictory to each other.

However, Boule-Vallois' book, considered as a whole, is an excellent treatise of human paleontology and deserves thankful acknowledgment and widest circulation. The reviewer is sure that the obvious incertitude of Vallois' present position on some fundamental questions will be replaced by a more precise one when — in the fourth edition — the new facts will be better known and understood, and all that is mortal of Boule be forgotten.

FRANZ WEIDENREICH
American Museum of Natural History

APES, GIANTS AND MAN. By FRANZ WEIDENREICH. The University of Chicago Press, vii + 122 pp., 1946. ($2.50).

This little volume by the distinguished anthropologist has, as the preface relates, grown out of the Hitchcock lectures given at the University of California in 1945. In 5 chapters the author expounds his conception of human evolution, starting with our simian ancestors, discussing the fossil human remains, especially (in the third chapter) those giant forms which were recently found in Java by Weidenreich's friend, G. H. R. von Königswald, and ending up with modern man, his races and his present evolutionary trends.

Those who have followed Weidenreich's earlier work — after he was dismissed by the French from Strassburg because of his German national status until he went to Peking (when the Nazis drove him out of Germany because of his non-German national status) — will find much in the first chapter that is familiar. The second and third chapter summarize in a similar manner the results of Weidenreich's work in Peking and New York.

The fourth chapter discusses the problem of man from the morphological, the constitutional and the serological (blood groups) standpoint. "The development and stability of constitutional and serological types . . . give evidence that geographical isolation . . . cannot have been a prerequisite for the establishment of speciations in man." It ends with the example of the Doberman pinscher who was bred in 1865 by crossing 4 races and who is now regarded as a "pure" race. "What, then, makes the difference between hybrids and 'pure' types, regardless of whether we are dealing with dogs or human beings?"

The last chapter "Form and Qualities of the Human Brain and Skull in the Light of Evolution" analyses the present trends of human evolution. The brain of man has ceased to increase in size, but as an analysis of the skull, particularly of the cranial index shows, it has assumed an increasingly rounded form. In order to strengthen this argument, Weidenreich endeavors to prove that the cranial index can undergo secular changes. The facts on which this thesis rests have frequently been explained by a substitution theory. This theory, "with all its consequences" is branded as "pure fantasy" and the "transformation" theory is put in its place. "When the Neanderthal phase was reached, the expansion stopped and the further development of the brain case went in the direction of brachycephalization."

Man branched off from the common stem not in the pleistocene but earlier, in the pliocene. Erect posture, and the corresponding transformations of foot and limbs must have been achieved first, "the enlargement of the brain is one of the latest steps" and "reached the climax of its development only after the upright posture had been achieved."

These short hints must suffice to indicate the wealth of ideas which the book contains. It is intended for a wider public. In spite of it, the professional anthropologist will do well to read, and ponder over, it. He will probably not agree with every sentence. But he will find the great lines of his science clearly drawn, and he will find much food for thought.

There are practically no disturbing misprints. Should one read, on page 28, sixth line from bottom "(new man)" for "(near man)"? The picture on the dust-cover shows a man endowed with a femur certainly not much longer than his humerus. Chapter I explains with great emphasis that the greater length of the femur relative to the humerus is typical for homo. Why did not the artist read the manuscript?

The usefulness of the book for the professional reader is increased by a good index and a list of 87 references.

This presentation of the mature thoughts of one of the foremost living anthropologists should be on the shelves of all his colleagues. We should hope for many further contributions from Weidenreich's pen!

GERHARDT VON BONIN
University of Illinois

DATING THE PAST: AN INTRODUCTION TO GEOCHRONOLOGY. By FREDERICK E. ZEUNER. Methuen, London, 385 pp. of text, 24 plates, 103 diagrams, bibliography and index, 1946.

This erudite and densely packed volume represents a first attempt to encompass the various methods of chronological measurement employed by scientists who work in the time depths below the historic calendar. Since our major use of these techniques centers around archaeology and human paleontology, the greater portion of the book is pointed in that direction. There are chapters on tree-ring analysis, upon the use of varves, upon terraces and raised beaches, upon the pollen analytical method, upon the evolution of the flint industries, rates of specific change in organisms whose evolutionary history is known, time measurement by radioactivity and by astronomical methods. The age of the earth and of the universe itself receive attention. The book is unique, vast in scope and reference, and a monument to its author's assimilative powers. It is not perfect — the author himself is quick to deny such omnipotence — but it is indispensable as the handbook of a new discipline whose technical demands are vast.

At first glance one is inclined to excuse the author for a rather superficial treatment of the literature dealing with pollen analysis in North America. After all the work was partly composed during the war years, and allowance must be made for this fact. Nevertheless he quotes from certain of the late workers of the forties in a manner suggesting total unfamiliarity with the long pioneer efforts of Paul Sears in the study of American bogs. With all due respect to certain of the workers mentioned by Zeuner, it was Sears who first interested American archaeologists in the pollen technique, and it is Sears today who, through the circulation of *The Pollen and Spore Circular,* has maintained and furthered the pollen interests of a variety of specialists in geology, botany, and archaeology. American pollen analysis is coming of age, but it is painful to one who has followed its slow early progress, to see its single greatest exponent ignored in a work purporting to be an exhaustive treatise of dating methods. Happily such lapses as this are not frequent.

Zeuner bases his estimates of Pleistocene duration upon astronomical theories involving perturbations of the earth's orbit which result in variations in the amount of solar radiation received by the earth. Since these astronomical movements can be accurately calculated, Zeuner regards this scheme as affording the most reliable system of dating when the periodic Pleistocene events are fitted into it. He argues that the theory fits our knowledge of Pleistocene stratigraphy so well that confidence in this absolute chronology is justified.

Other geologists are apt to tread more cautiously at this point, but the subject will have to be settled outside of the discipline of anthropology. Zeuner may be right, but his trust and confidence in the absolute scale will not be shared by all. Curious, in this connection, is a fact commented on by the author himself; namely, the almost incredible conservatism of the lower paleolithic industries, the middle stage of the Acheulian (Acheulian III to V) by itself lasting some 200,000 years, according to the absolute scale. Certainly the first steps in culture are the hardest. Nevertheless this long-drawn-out cultural stagnation on the part of a creature who, Zeuner believes, was already a fully equipped *sapiens* type, implies a remarkably static mentality. I do not say Zeuner's time scale is wrong; I do say that a problem of this sort demands more attention than the author has devoted to it.

One new method of attempting an absolute chronology for the Pleistocene has been overlooked: the study of radium concentrations in sea floor sediments. It has been found in the last few years that the amount of radium in marine sediments varies with time, and that in this way the age of a particular sedimentary layer may be determined against a standard curve of radium concentration. This method is not the same as the helium and lead methods used for rocks of greater age. Instead, because of technical difficulties, the method seems, at present, feasible only within a 400,000-year limit.

I have mentioned omissions such as this because they do not represent an exhaustive search on the part of the reviewer nor an intimate acquaintance with all the fields dealt with. They thus make evident the frank impossibility of any one man's digesting, in a completely satisfactory manner, so enormous a range of material. I have said, and I reiterate that Zeuner's book is a valuable and, on the whole, comprehensive treatise, though somewhat uncritical in its devotion to the astronomical absolute chronology before the latter has received complete acceptance. If one makes allowance for this bias on the part of the author, the book will be found most useful indeed. The bibliographies are extensive, and many little known or isolated data are drawn together and given meaning. The student and the scholar can use it equally. Nothing like it exists in the literature.

LOREN C. EISELEY
Oberlin College

PATTERNS OF MAMMALIAN REPRODUCTION. By S. A. ASDELL, M.A., Ph.D., Professor of Animal Physiology, New York State College of Agriculture, Cornell University, Ithaca, N. Y. Comstock Publishing Company, 1946, x + 437 pp. ($5.00).

In structure and in function the mammalian reproductive system differs more, from one species to another, than any other system. The diversity of cyclic rhythms and of mating habits is obvious, and is matched by structural differences. An experienced histologist can identify, for example, from a slide of the ovary, any species he has previously examined. The research of recent decades has begun to reveal some of the patterns underlying all this diversity. Professor Asdell has undertaken the very useful task of bringing together the available information on mammalian reproduction, species by species, with emphasis on the quantitative aspects.

Planned to achieve as much of a synthesis as possible, the book opens with a 30-page summary of the physiology of reproduction in mammals. The chapter on each order of mammals in turn opens with a brief account of the patterns within the order as far as they are presently discernible. Each species about which anything is known is then reviewed. The rabbit gets 20 pages, whereas 11 words suffice to tell all that is known about reproduction in the hoolock gibbon. Information on the little-known species is gathered into tables at the end of each chapter.

The information presented covers the breeding seasons, estrual or menstrual cycles, litter size, histological changes, hormone levels and many other physiological facts. Statistical data are clarified by statement of the ranges and modes, and of the probable errors, often on the basis of recalculations by Dr. Asdell.

Readers of the American Journal of Physical Anthropology will be especially interested in the chapter on the primates, from the lemurs to man. The general impression gained from this pioneer assemblage of information is to blur, at least a little, the supposed differences between the platyrrhines on one hand and the catarrhine monkeys and the anthropoid apes on the other. Many of the platyrrhines exhibit at least rudimentary menstruation; some of the old-world forms exhibit cyclic variations of libido resembling estrus. The average cycle length in those primates known to be polyestrous or to menstruate varies from 23 to about 35 days in different species. There are not as yet many helpful physiological clues to evolutionary relationships among the higher primates. The human cyclic interval, for example, is closer to that of the rhesus monkey (28 days) than to that of the chimpanzee (34 days), but the chimpanzee alone among the mammals yet studied resembles the human species in eliminating progesterone in the urine as pregnanediol glycuronidate.

Specialists will doubtless be able to provide additions and corrections of detail. In the choice of zoological nomenclature Dr. Asdell had to wrestle with a confused situation. Now that certain taxonomists have done their worst, an anatomist or physiologist is more likely to be understood, at least when writing about primates, if he uses the common name rather than the technical term. Our author has disarmed criticism in this respect by a prefatory explanation. The plates, which some readers have found irrelevant, are intended to illustrate characteristic histological and physiological features of the cycle. They would be more useful if directly keyed to the introductory chapter or (augmented) to the individual species to show differences. Taxonomy and illustration are, however, secondary considerations. When an experienced investigator takes the time to compile a comprehensive and critical reference book like this one, he deserves the special thanks of his colleagues.

GEORGE W. CORNER
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POPULATION IN MODERN CHINA. By TA CHEN. The University of Chicago Press, Chicago, Ill. ix + 126 pp. 1946. ($2.50).

Census data and vital statistics are important to anthropology, casting light both upon man's social institutions and his biology. They reflect, indeed, those interactions between the two which require the existence of anthropology as a single and distinct discipline. Consequently a book such as Ta Chen's "Population in Modern China" will be of great interest to the profession as a whole; and particularly so because it fills a serious gap in our knowledge. This slight volume provides the only summing up and analysis of information on the various attempts at census taking and the registration of vital statistics in modern China.

China is a nation about which, despite its great anthropological interest, we have all too little comprehensive information. Many studies of various small areas have been made both in physical and in social anthropology. Not all have yet been published and few have anything like the scope of Dr. Ta Chen's work. It covers the history of Chinese census-taking, analyses of 10 sample and experimental enumerations undertaken in recent years, and full explanation, both of the techniques used and of the conclusions which can be drawn. The appendix presents figures from enumerations and registrations, with comparative data, in 65 tables. Less than 1% of China's presumptive population is covered by these enumerations, but they are sufficiently well distributed to be considered as representative, granted their accuracy.

Of particular interest to physical anthropologists is the information on birth and death rates, sex ratio, family size and morbidity. It appears that in China not only is the number of males greater at birth, but that they survive in greater numbers than females; the sex-ratio averages 112 : 100 and runs up to 129.4 : 100. Nevertheless the proportion of widows to widowers is even greater than among ourselves. From 4.35 to 6.24% of males are widowers, but from 10.94 to 21.00% of females are widows: widowers tend to remarry, but widows find it very difficult to find new husbands. A purely social bias has a strong effect upon each succeeding generation.

Dr. Ta Chen estimates that at present the Chinese birth-rate averages about 38 per 1,000 and the death-rate 33 per 1,000. Sons are economically useful and socially desirable to each family, and it is far easier to produce children than keep them alive. However, enough of them live to ensure most families against extinction. The size of the family unit varies, by locality, from a mean of 4.18 persons to a mean of 6.17. It is of particular interest that landowners seem to have more children than tenants; townsmen more than farmers: and laborers the least of all. Of course this is in part due to the very high infant mortality, which runs from 212 per 1,000 on up to over 500 and which is much higher among the poor than among the rich. The eugenic implication is that the Chinese are increasing in fitness far more rapidly than we, for it is a rigorous selection, and the socially successful leave the most descendants. But one wonders whether the actual results are a sufficient reward for such biological virtue.

The scarcity of western-trained physicians makes the correct recording of cause of death difficult, as the author points out. Taking the records at their face value, in the single county where registration was attempted for a period of several years we find that a cholera epidemic caused about 12% of deaths: the proportion was even higher among women and children. Other definitely infectious diseases accounted for 25%. The omission of leprosy and malaria from the list, in view of their known prevalence, detracts greatly from the validity of this registration. Such attempts at enumerative studies serve as good training for the participants rather than as data for scientific conclusions.

In view of the quantity and quality of his basic data, Dr. Ta Chen has turned out a very sound study. The difficulties of collecting census data and registering vital statistics in China are huge. False starts and errors have been all too frequent, and he never hesitates to point them out. But from a study of all the available material he has succeeded in producing a book which not only is informative but which gives promise of more and better things to come.

F. S. Hulse
Colgate University

WHAT IS LIFE? THE PHYSICAL ASPECT OF THE LIVING CELL. Erwin Schrödinger. The Macmillan Company, New York. 1946. Pp. viii plus 91 ($1.75). (Illustrated.)

In this little series of lectures a physicist, a Nobel laureate, not only looks at biology; he also applies the findings of physics and chemistry to the observations of biologists and he then proceeds to some new biological theories of his own.

The argument is straightforward. Its very naiveté is refreshing. It is based, with a few exceptions, on material already well known to students of physics and genetics.

The author points out that physical laws are laws of chance based on the statistical probabilities of the movements of large numbers of atoms. It follows that organisms — such as ourselves — must be very large when compared to the atom if we are to act in any sort of orderly way — develop orderly thought, for instance. Now the most essential part of an organism, the chromosomes (which control the whole course of development of the body and reduplicate themselves in the same individual and between individuals for generations), are not so large but what they are occasionally subject to the chance impacts of atomic movements. Ionization, or some similar process, can produce a mutation or chance change in the chromosome. In order for life to exist, however, mutations must not be too frequent, for in that case disadvantageous mutations would usually occur in the same individuals as advantageous ones and natural selection would have no material on which to operate.

The stability of the genes is explained in terms of quantum theory. At body temperatures the energy threshold required to convert a gene to one of its isomeres is apparently rarely met. With x-ray it can be more frequently reached. In the light of this discussion the gene must be thought of as a large molecule — an "aperiodic crystal" — in which every atom or group of atoms plays an individual role not entirely equivalent to that of others. Perhaps the whole chromosome — the "code-script" for organic development — is an aperiodic crystal of this kind. If we are to understand how such a chromosome can be in a one-to-one correspondence with a highly complicated and specific plan of development and can put it in operation, we shall need a new physics based on the order-out-of-order principle rather than the order-out-of-chaos principle of statistically summarizing the activities of atoms. Living matter behaves more like substances close to a temperature of absolute zero — evading the decay to equilibrium. But in the case of organisms the effects of entropy are averted by extracting or feeding on order from the environment.

The author is aware that physics today cannot provide explanations of phenomena occurring outside the realm of classical statistical probabilities occurring with reduplication of identical atoms — as in a periodic crystal. He is content to show that the laws of an aperiodic crystal would be different and that they might be ascertained. He closes with a discussion — quite unwarranted if this is to be considered a scientific presentation — of the philosophical implications and speculates that consciousness, as we know it, is always singular. By the principle of the order-from-order physics he explains the astonishing durability of life — life which he thinks must be eternal and must be inherent in ourselves.

Whatever our disagreements with the more speculative interpretations, Professor Schrödinger has certainly provided us with a stimulating review of genetics in terms of atomic principles. He discusses all the major phenomena (dominance, mutation, crossing over, alternation of generations, mitosis and so forth) in terms of the atomic components and he does it without the physicist's most dreaded weapon, mathematical deduction, ''not,'' as he says, ''that the subject was simple enough to be explained without mathematics, but rather that it was much too involved to be fully accessible to mathematics.''

Gabriel W. Lasker

NOT BY BREAD ALONE. By Vilhjalmur Stefansson. The MacMillan Company, New York, xvi + 339 pp., 1946. ($3.50).

The book is a presentation of evidence to show that a strictly meat or meat and fish diet is adequate for man, both for the maintenance of a state of good health and the yielding of energy sufficient for hard labor. As a source for his material, the author utilizes his extensive and interesting experiences among the Eskimos of Alaska and Northern Canada. An able explorer, he learned to live with these people as a native and to enjoy their diet. His observation that an adequate amount of antiscorbutic and other vitamins to prevent scurvy and ill health are found in raw and partly cooked meat and fish has been corroborated by other explorers, particularly Peary.

In support of the general thesis of the book, Stefansson describes in popular terms the dietary experiment which he and a fellow explorer, a young Dane named Karsten Anderson, undertook at the Russell Sage Institute of Pathology, affiliated with Cornell University Medical College and Bellevue Hospital, under the direction of Dr. Eugene F. DuBois. Stefansson and Anderson were able to live for a year on all meat diet without producing any striking departures from the normal metabolic equilibrium of the body.

He describes the struggles of well known British explorers in the Arctic and Antarctic regions with scurvy, stressing the tragedy of their failure to use raw and partly cooked meat when available. His graphic account of the early fur trade rivalries of the Hudson Bay Company's and the North West Company's traders is made to serve as a vehicle for emphasizing the adequacy of pemmican as a compact and nutritionally adequate food.

The book affords interesting reading as a story of adventure. The actual evidence in support of the primary thesis could be presented in a much briefer report, but as such it would lack the popular appeal undoubtedly sought by the author.

PETER HEINBECKER
Washington University, St. Louis

MURDER IN THE NAME OF ANTHROPOLOGY.— The report of the Mission to the European Theater Concerning War Crimes of a Medical Nature showed that certain German physicians and scientists were involved in the perpetration of both nonexperimental and experimental crimes and barbarities. . . One series of murders was done to provide skeletons for an anthropological museum.— Editorial. J. Am. Med. Assn., vol. 132, no. 12, 1946, pp. 714–715.

CONTEMPORANEITY OF HOMO AND PITHECANTHROPUS.— Some scientists have maintained that the Piltdown jaw does not belong with the Piltdown skull, but represents a fossil ape whose remains by chance became embedded in the same gravel patch as the skull. Those who hold that the jaw does go with the skull have argued, and still argue, that it would be too great a coincidence to have a human skull and an ape jaw preserved as fossils in such close proximity. Now, . . . in 1942 we found on Rusinga Island [in Kenya] a *Proconsul* jaw and the jaw of *Xenopithecus* — an entirely different genus — within 15 feet of each other and within the space of a few minutes. That represents quite as great a coincidence as the association of a fossil human skull and an ape jaw in the Piltdown gravels, and adds fresh weight to the views of those who hold that the Piltdown skull is human — a true *Homo* — while the Piltdown jaw is that of an ape. If this is true, then the Piltdown skull provides one more piece of evidence pointing to the early emergence of *Homo* as a distinct genus, contemporary with, but only distantly related to, the more primitive type of man represented by the genus *Pithecanthropus,* to which both the Java and Pekin skulls belong.— L. S. B. Leakey. Fossil finds in Kenya: Ape or primitive man? Antiquity, no. 80, Dec. 1946, pp. 201–204 (includes views of the new Proconsul jaw).

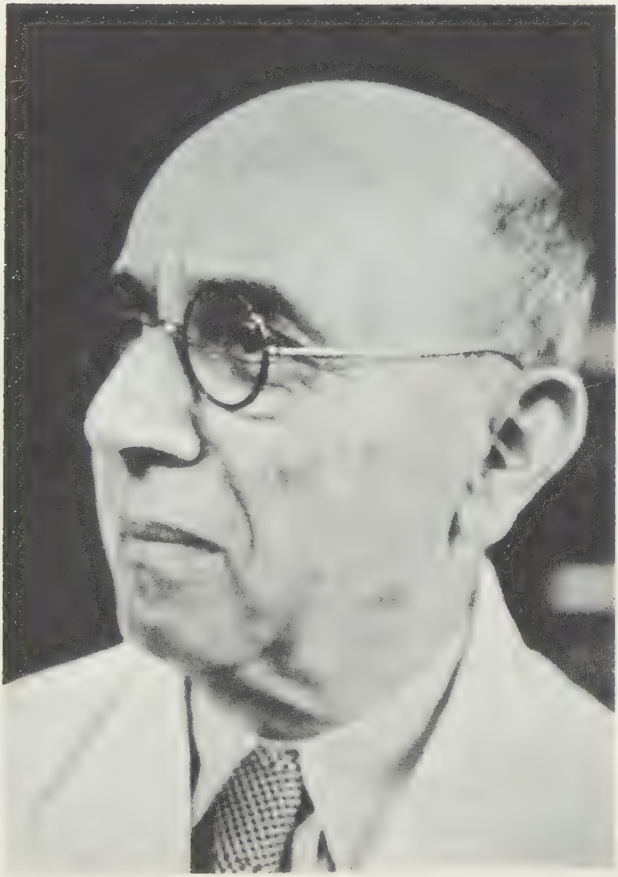
Expanding Birth Registration Area.— The growth of the registration area for births has always lagged behind that for deaths; and it is only since approximately 1930 that the area has comprised the States in which the majority of Negroes live. The birth registration area in 1920 included 22 States and the District of Columbia or 62% of the white and only 29% of the Negro population. By 1927 representation was appreciably better, including 40 States and the District of Columbia, or 90 and 72% of the white and Negro populations, respectively, as enumerated in 1920. Since 1933 all States have been included in the birth registration area.

The completeness of the reports of birth, as well as the States represented in the birth registration area, has also lagged behind that for deaths. By a process of matching birth and death certificates and enumeration records, the Bureau of the Census has concluded that birth registration in 1940 was 94% complete for the total white and 82% complete for the total nonwhite populations of the United States. There were approximately 25 and 50% of States in which 10% or more of births occurring in 1940 were not registered for white and Negro populations, respectively. . . Registration is also less in rural than in urban areas, 97 and 90% for white and 92 and 77% complete for nonwhite population in urban and rural areas of the United States, respectively.— Mary Gover. Negro mortality: II. The birth rate and infant and maternal mortality. Public Health Rep., vol. 61, no. 43, 1946, pp. 1529–1538.

NOTES

FRANZ WEIDENREICH
FIRST RECIPIENT OF THE VIKING FUND MEDAL AND PRIZE IN PHYSICAL ANTHROPOLOGY

At the annual meeting of the American Association of Physical Anthropologists at the Palmer House, Chicago, on December 28, 1946, Doctor Weidenreich, having been unanimously nominated by a special



committee of 9 members of the society, was awarded the $1000 Viking Fund Prize in Physical Anthropology. In making the award. Dr. Wilton M. Krogman called attention to Doctor Weidenreich's more important publications and especially to his recent contributions to the knowledge of fossil man in China and Java. In responding, Doctor Weidenreich mentioned that with the coming of Nazism to Germany he had left for China, fortunately arriving just as the remains of Peking Man were being uncovered. He pointed out that he was merely the interpreter and recorded his obligations to the men who had made the original finds. He also emphasized his gratitude to the United States where, in recent years, he has been able to continue his work as a Research Associate of the American Museum of Natural History in New York.

Physical anthropology in America has profited greatly from Doctor Weidenreich's presence and from his readiness to place his great knowledge and experience at the disposal of his younger colleagues. He is best known, perhaps, for his monographs published between 1936 and 1944 on the mandible, dentition, extremity bones, and skull of *Sinanthropus pekinensis.* Within the last 2 years he has published the epic "Giant Early Man from Java and South China," "The Brachycephalization of Recent Mankind," "Apes, Giants and Men" and other works. Members of this Association look forward with keen anticipation to each new publication by Doctor Weidenreich and welcome every opportunity to hear him interpret the course of human evolution.

ANTHROPOMETRIC INSTRUMENTS

The 2 calipers shown on figure 1 were designed especially for the students in the author's anthropology class. These students are missionaries and missionary candidates. They are taught the principles of anthropometry, but due to the exorbitant price of standard anthropometric tools most field measuring has been impracticable. Consequently for the last 2 years I have been laboring to get tools at a price commensurate with the economic standard of missionaries and graduate students in general. These instruments are well illustrated in the photograph and are made by The Swan Tool and Machine Company, 30 Bartholomew Avenue, Hartford, Connecticut. The price of each caliper is $7.50 or $15.00 per set. If desired they may be ordered directly from the company.

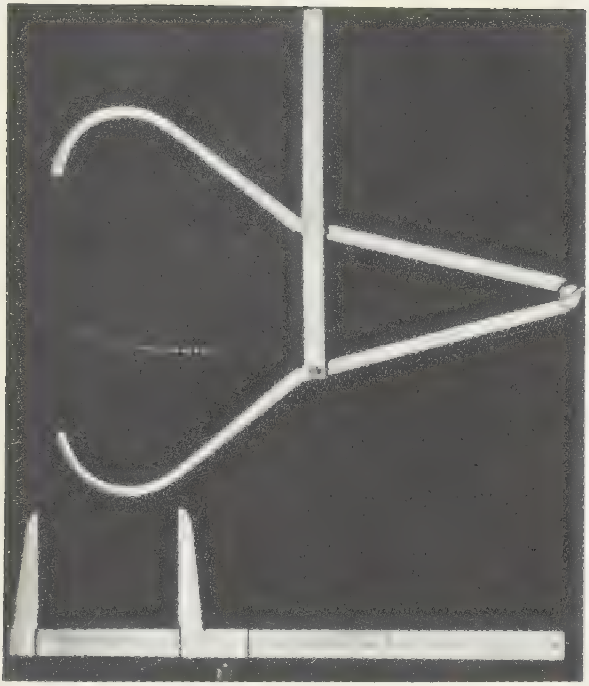


Fig. 1 Anthropometric instruments made by the Swan Tool and Machine Company, Hartford, Connecticut.

I am now working on a cheaper anthropometer and also a weighing scale which will be light in weight and usable in the jungles of a tropical rain forest.

Morris Steggerda,
Kennedy School of Missions
Hartford Seminary Foundation
Hartford, Conn.

A SIMPLE TEST FOR THE DEMONSTRATION OF THE IRON PIGMENT OF RED HAIR

Although it is generally accepted that the color of red hair is inherited, the mode of transmission of this trait is still not well understood. One of the difficulties of studying the inheritance of red hair color is the fact that there are no objective criteria which would sharply distinguish red hair from hair of other shades with a reddish tinge. Geneticists agree that the red hair color depends on a factor which is inherited independently from the factors determining brown or blond hair. However, no conclusive proof has been offered for the existence of such a factor.

As early as 1878, Sorby, a British mineralogist, extracted a pink coloring matter from bright red human hair by boiling it with sulfuric acid. He found this colored compound in bright red human hair exclusively (Sorby, 1878). No attention was paid to this important finding for 65 years. In 1943 the pigment responsible for the pink color of the acid extract of red hair was isolated by us. It was found that this pigment contained iron and that it differed in many respects from all hitherto described cutaneous pigments of mammals. The pigment was bright red when extracted with acids, and this color turned yellow or brown in an alkaline medium. The color change was reversible. In acid solution, the pigment had a characteristic absorption band with a maximum at 535 mμ. The pigment was precipitated from its solutions at the neutral point (Flesch and Rothman, '45).

Since it is very easy to extract and identify the iron pigment of red hair without any elaborate equipment, we developed a simple test which can be used to show its presence in small amounts of hair.

The procedure is as follows:

PROCEDURE

1. Place hair into flask and keep it in chloroform for 24 hours.
2. Transfer hair into a second flask and keep it in acetone for 2 to 3 hours.
3. Transfer hair into a third flask and keep it in glacial acetic acid for not longer than 12 to 16 hours.
4. Wash hair in running water on filter paper in a funnel and dry it in the air.
5. Place dry hair into a beaker and add a 2% solution of hydrochloric acid. Five ml of acid should be added for each 0.1 gm of hair.
6. Boil it over a low flame for 1 hour. From time to time replace evaporated fluid with hot water from a pipette.
7. Pour acid extract from hair into another beaker and boil the extract until its volume is reduced to about one-third of the original.

RESULT

1. If iron pigment is present in the hair, the fluid will show a distinct pink color, best seen against a white background.

2. Extracts of black, brown and blond hair, which do not contain iron pigment, will be colorless or pale yellow.

VERIFICATION TEST

If there is any doubt as to whether the resulting color was pink: (1) add 20% sodium hydroxide solution drop by drop until the color turns yellow: (2) add concentrated hydrochloric acid drop by drop. Extracts containing iron pigment will turn pink again on addition of acid.

With this method it is possible to detect the iron pigment in as little as 0.1 gm of hair. However, to obtain clear-cut results, it is advisable to use not less than 0.2 gm of hair. This is very little since one haircut yields about 5–7 gm of hair.

We were unable to show the presence of the red iron pigment in the hair of red horses, dogs, cats and rabbits. As yet, we have had no opportunity to examine the hair of red monkeys.

It is noteworthy that the iron pigment in human hair seems to contribute little or nothing to the color of red hair. After its complete extraction which can be invariably achieved in 2 hours, the hair still appears red. Nevertheless, the constant presence of the iron pigment in red hair indicates that it plays a role in the pigmentation of red-haired persons. We found it in many shades of red hair, including red-brown and red-blond shades, but never in brown, blond or black hair. Since the amounts of hair required for the test are small, it will be possible to use this test for mass examinations in genetic studies.

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SORBY, H. C. 1878 J. Anthropol. Inst. of Great Britain, *8:* 1.

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Department of Pharmacology and the Section
of Dermatology, Department of Medicine,
University of Chicago, Chicago, Illinois

Erupted Teeth Protected by Fluorine.— In the course of systematic dental examination of persons of Japanese ancestry residing in War Relocation Authority centers, two groups of children at two different centers were examined in the summer of 1943 and again in the summer of 1945. Early in 1942 both groups, because of their Japanese ancestry, had been transferred with their parents from homes in Los Angeles and environs to an assembly center near Los Angeles. In the autumn of 1942 they were again transferred, 120 to a center in California and 196 to Arizona.

The children relocated to the California center consumed fluoride-free water originating from melted snows coming off a precipitous mountain rising to a height of more than 14,000 feet, less than 20 miles from the residence area. Analysis of this water revealed a fluorine content of 0.1 p.p.m., a value within the error of measurement. The children relocated to the Arizona center consumed water originating from two deep wells drilled through the desert floor to a depth of approximately 400 feet. This water contained fluorine to the extent of 3 p.p.m. Water from the central source was piped to each family apartment in both centers.

Analysis of the dental findings obtained in 1943 and in 1945 reveals that a fluorine content of 3 p.p.m. in the drinking water is associated with a marked reduction in new caries in teeth present in the mouth and free of caries at the beginning of exposure.

The data are sufficient to indicate that exposure of the erupted permanent teeth of younger children to fluoride waters provides a larger measure of protection against caries than does the same exposure of the erupted teeth of older children. It follows therefore that, among teeth present in the mouth at the beginning of exposure to fluorine, those most recently erupted were those most protected against caries attack. — Henry Klein. Dental caries experience in relocated children exposed to water containing fluorine. Public Health Reports, vol. 60, no. 49, 1945, pp. 1462–1467.

THE RYUKYU PEOPLE

A BIOLOGICAL APPRAISAL

MARSHALL T. NEWMAN AND RANSOM L. ENG
U. S. National Museum, and former Executive Officer,
Military Government Research Center, Okinawa

ONE FIGURE

INTRODUCTION

As United States forces conquered island after island in the Pacific, hitherto obscure peoples suddenly became headline news. Such a people were the Ryukyuans who were living a simple agricultural existence far removed from the home islands of Japan as vassals of the Japanese. But with its invasion on April 1, 1945, Okinawa became a household word almost overnight. After organized Japanese resistance ceased following 82 days of bitter fighting, Okinawa reappeared in the news as one of the reduced-status bases retained by the United States.

Until the war, Western literature on the Ryukyus was meager, but then the pressing need for information resulted in the collation of excellent data, largely from Japanese writings. The best source material is in the Navy Department's Civil Affairs Handbook (hereafter abbreviated C.A.H.), based largely on work of the Navy Research Group at Yale University, growing out of the cross-cultural survey, and using additional information from the Office of Naval Intelligence, Military Intelligence Service, Department of State and the Bureau of Economic Warfare. The Office of Strategic Services, Okinawa Studies no. 3 (hereafter abbreviated O.S., no. 3) written by Prof. A. M. Tozzer of Harvard University are

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also useful. After the invasion of Okinawa, more information on the natives was collected by military and naval personnel. This report is a summary of these and other data dealing with the racial history and present physical status of the Ryukyu people, although certain sources wholly in Japanese have not received full treatment.

Acknowledgments are due to Lt. Col. H. Grant Taylor and Cdr. Leon Lewis, former commanding officers of the Military Government Research Center, Okinawa, who made the M.G. Height-Weight study available to us; to Mr. Robert Saldutte who loaned us the Military Government C-2 War Diary; to Dr. Frederick Hulse for permitting us to use the Akita and Mizusawa data; to Mr. Henry B. Collins, Jr., Prof. George P. Murdock and Dr. Irene B. Taeuber, who criticized the manuscript. We wish to thank the Navy Department for permitting us to quote from their restricted Military Government report.

THE PEOPLING OF THE RYUKYUS

The Ryukyu chain (fig. 1) has been termed a museum of the past by Denzel Carr (O.S., no. 3, p. 52), who sees there 3 culture strata: Proto-Japanese or Prehistoric, Chinese, and neo-Japanese, with the common people in the rural districts little influenced by the last 2.

It is likely that prior to the Proto-Japanese phase, Ainu-like people inhabited at least part of the Ryukyus (O.S., no. 3, p. 7), but the evidence is not entirely conclusive. Since the cultural status of the Ainu first reaching Japan is unknown, it is impossible to identify the earliest sites with them (Schnell, '32, p. 21). The Jomon pottery complex in North and Central Honshu is definitely Ainu, but dates no earlier than the third century A.D. Although pottery of this complex is not found in South Japan and the Ryukyus, Ainu place names are found as far south as Osumi province, South Kyushu (Chamberlain, 1887, p. 74) and Tei-Ichi (Chamberlain, 1895b, p. 317) claims, on apparently insufficient evidence, 2 such place names in

Sakishima Gunto. Furthermore, alleged Ainu artifacts have been found along the Ryukyu chain. Carr (O.S., no. 3, p. 7) reported them extending south to Yaku Jima in the Northern Ryukyus. Monro ('11) found burials, including skeletons, which he believed to be Ainu, in the Ryukyus. Torii ('05)

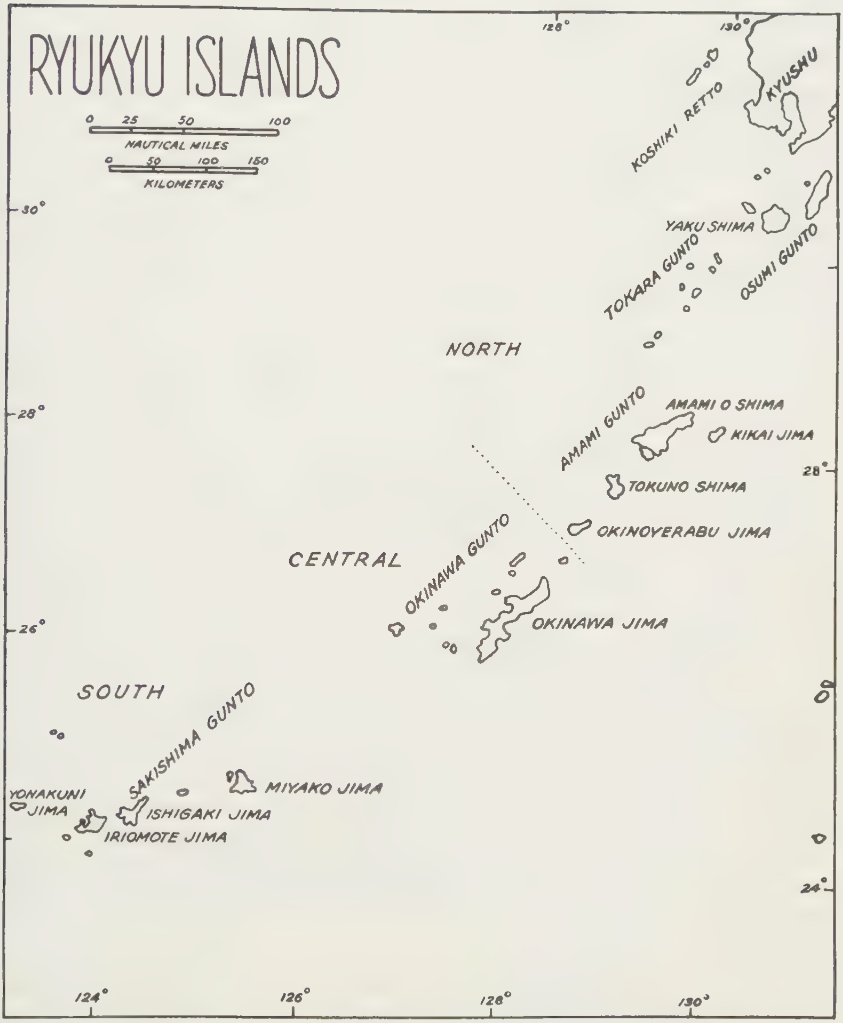

Fig. 1 Map of the Ryukyu Island chain (from Navy Department Civil Affairs Handbook, p. v.).

reported ceramics and stone work of Ainu design from excavations at Nakagusuku Wan, Okinawa Jima. Similar finds have been made in other localities, e.g., on the Goshikidake, southeast of Naha (Simon, '14, p. 11).

Tozzer (O.S., no. 3, p. 7) and Dixon ('23, p. 292) follow Chamberlain (1893, p. 279) in believing that the first Japanese to reach Kyushu drove most of the Ainu inhabitants north, pushing a small number south along the Ryukyus. Thus the Ainu occupation there may have been later than in the main Japanese islands. Schnell ('32, p. 21) suggested that the Ainu entered Japan via Formosa and the Ryukyus, citing cultural (Sternberg, '29) and physical evidences of their southern route.[1] Possibly the early Japanese were later travellers along this route, if there is validity to Matsumoto's ('28) contention that Japanese is related to the Austronesian group of languages. Without going into detail, it seems these claims of far-flung linguistic affinities often rest on insufficient evidence.[2] Bishop ('26, p. 551) feels that evidence points to the Amur region as Ainu homeland. He also indicates (fig. 1, pp. 552–559) that the Korean route of entrance to Japan was the most heavily travelled, and does not attempt to bring either Ainu or Japanese in by the Ryukyu chain. We must agree that the Ryukyus were probably not a migration route to Japan in early times. The strong resemblance of Japanese Yayoi pottery to Neolithic wares of South China is no proof of a connection via the Ryukyus, since the former is derived from the Korean Neolithic (Ward, '38). Nor is it necessary to imply a direct connection by sea or the Ryukyus between the leptorrhine, high-headed brachycephals of Shantung and Kiangsu provinces, China, and similar people in South Japan (Hulse, '43, p. 132). The Ryukyu route in this case is out of the way, and overland connections are more direct through Korea. It seems more likely, therefore, that the Ainu moved through Korea to Kyushu. The early Japanese followed them before the third century B.C., pushing some Ainu south along the Ryukyus. Some of these Japanese settled in the Ryukyus possibly much in the manner described in the *Nakayama Seikan,* the oldest document of the area. Thus prior to the first Chinese contact, the Ryukyus housed both peoples, with the early Japanese more numerous.

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[1] Schnell ('32, p. 21) states "The exceptionally long hair on face and body that is a marked feature of the Ainu race most closely resembles the types inhabiting the East Indies." Presumably he is referring to "Veddoid" peoples like the Toala of the Celebes, and some of the Dyak peoples, although these people are not hairy. Closer resemblance is probably to be found in Birdsell's Southern Australian or Murrian people.

[2] Japanese, with Ryukyuan as its sister tongue, is an independent linguistic group. It is not apparently related to Korean, Bishop ('26, p. 558) to the contrary notwithstanding. Bishop also suggests that the Iron Age Yamato people, bearing the trappings of Central Asiatic horse culture, introduced Japanese into Japan during the second century A. D.

These early Japanese, bearing a maritime culture of South Asiatic character, were apparently part of a movement stimulated perhaps by the coastward expansion of the Chinese in the second and first milleniums B.C. (Bishop, '26, p. 553). In physical type they were closely related to the Southern Mongoloids. In Japan this is the so-called Satsuma type, predominant in southern Kyushu and Shikoku. It is characterized as short, brachcephalic and short-faced, and corresponds to the "coarse" or peasant type of Japanese described by Baelz (1883).

Further movements from Korea into Japan may have affected the Ryukyus only to the extent of pushing more of the early Japanese south. Apparently the Iron Age Yamato people exerted no influence there. In fact, the conservative and separatist tendencies of South Kyushu may have shielded the Ryukyus from later cultural and racial influences from the north. Although the Yamato overlords gradually absorbed the independent Japanese kingdoms, the people of South Kyushu held out until after the seventh century A.D., and the Satsuma rebellion of 1877 serves to emphasize their recent separatist feelings.

The Chinese were aware of the Ryukyus as early as the third century B.C. (O.S., no. 3, p. 38). Definite mention of contact dates to 605 A.D. when the Chinese sent an information-collecting embassy to the islands.[3] The first known Japanese contact with the Ryukyus was in 617 A.D., when people from Yaku Shima visited the court of the Japanese empress. In this early period, cultural relations with Japan were even more tenuous than with China. However, Japanese legendary history mentions emigration to the Ryukyus in the eleventh and twelfth centuries, and possibly earlier (Simon, '14, pp. 12–14). These movements, perhaps only small groups of highly placed persons, were said to have resulted from strife in South Japan. Japanese tombs possibly from this period are found as far south as Ishigaki and Yonakuni Jima. Some of the emigrés were princely people who established dynasties in the Ryukyus, e.g., Tametomo, presumed father of King Shunten, who ruled Okinawa from 1187–1237. His dynasty endured until the 1870's. By the fifteenth century, unified rule of the Ryukyus from Okinawa was established.

The year 1372 A.D. marks the heightening of Chinese influence. At that time the Ryukyus began paying regular tribute to the Chinese court. From then until about 1609, Chinese influence was especially heavy. Chinese traders were given concessions at Naha and other cities. Ryukyu youths often went to China for their education. Even the form of the much publicized Okinawan tombs came directly from South China. China did not attempt to colonize the Ryukyus, and to this day people of Chinese extraction there are almost wholly city dwellers.

Commencing in 1451, the king of Okinawa was forced to pay tribute to the Japanese. In 1610, after the Korean War, the Prince of Satsuma conquered the North and Central Ryukyus. The North Ryukyus were ceded to him, and have since remained part of Kagoshima prefecture, which includes Satsuma and Osumi provinces as well. Since China's ports were closed to Japanese ships from 1552–1643, and in 1636 the Tokugawa shogunate forbade Japanese merchants to leave their country, both China and Japan found the Ryukyus highly useful as a means of indirect trade. Thus, until Admiral Peary broke the Japanese policy of seclusion in 1853, the Ryukyus were the gateway of trade to Japan. But during this time, Chinese rather than Japanese cultural influence was greater in the Central and South Ryukyus at least. With the formal annexation of the Ryukyus by Japan in 1871, Chinese influence largely died.

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[3] Much of the following information on Ryukyu history was derived from the Navy Department's Civil Affairs Handbook.

There can be no question that even prior to 1871, Japanese influence was felt in the Northern Ryukyus. The coastal dialect of Amami O Shima is said to be "very like Japanese" (Simon, '14, pp. 13–16). The Ryukyuans of Osumi Gunto and part of Tokara Gunto adopted the Satsuman dialect, mutually intelligible with the Kagoshima dialect of South Kyushu. Physically the Ryukuans of these 2 northern groups are "very similar to Kyushu Japanese" (O.S., no. 3, pp. 6–7).

With the Japanese annexation of the Ryukyus, tribute to China ceased. In 1875 Japanese garrisons were placed in the islands, and some miscegenation undoubtedly took place just as it did in 1944–1945. But the number of outsiders in the Ryukyus has always been small, since the islands' meager attractions have never encouraged immigration. Furthermore, since 1900 the Japanese have discouraged immigration of Chinese and Formosans into the Ryukyus. Immigration has been negligible, especially since 1920. In that year 98% of the people in Okinawa prefecture were born there, while 1.6% came from other Japanese prefectures. Many of the latter were probably Ryukyuans from Kagoshima prefecture (C.A.H., p. 253). Only 0.3% were "foreigners." In 1940 only 0.3% came from other prefectures with 0.1% "foreigners" (C.A.H., pp. 50–51). In Okinawa prefecture, in 1930 there were only 204 Formosans, 48 Chinese, 20 Koreans, 10 Russians, 2 Americans and 1 other foreigner (O.S., no. 3, p. 3). In 1935, for all the Ryukyus, the list includes 155 Formosans, 61 Mandated Islanders, 49 Koreans, 5 Manchurians and 109 others, mostly Chinese and Hawaiian (C.A.H., pp. 50–51). Some of the latter doubtless were repatriated

Ryukyuans. The total number of foreigners, then, was 379 in a population of 879,193.

Interbreeding between Ryukyuans and others is restricted by social barriers. Many of the Formosans kept to themselves, e.g., those who came to cultivate rice at Nagura town, Ishigaki Jima (C.A.H., p. 33). Since the Japanese look down on Ryukyuans as uncouth rustics, and the Shi class among the latter have considerable family pride, intermarriage is rare. On the part of the Japanese, social recognition of physical differences plays a rôle in that their prejudice was apparently heightened by the greater hairiness of the Ryukyuans (C.A.H., p. 69). The Japanese have long used hairiness as the basis of racial propaganda against other peoples. It is interesting to note that Chinese feel the same way about Japanese and allude to them variously as ''monkey men'' or ''hairy men.'' The epithet ''Pork-Eater'' is applied to Ryukyu people by the Japanese, and may involve another criterion of their racial prejudice — ''the unpleasant body odor attributed by most Japanese to a diet including considerable amounts of meat.'' (C.A.H., p. 69.)

It seems, therefore, that in historic times, the few cities absorbed most of the small amount of Chinese, Japanese and other foreign elements to which the Ryukyus were exposed. The city people are said to be physically and socially distinct from their rural compatriots (O.S., no. 3, p. 14). But most Ryukyuans live in rural areas. In 1930, about 72% of the gainfully employed in Okinawa prefecture were reported as farmers. They have been largely untouched by either Chinese or recent Japanese influence, racially speaking, but certain esoteric aspects of their culture seem almost directly Chinese.

THE PHYSICAL CHARACTERISTICS OF THE RYUKYU PEOPLE

Whereas the physical differences between Ryukyuans and Japanese are slight, an experienced observer can distinguish one from the other in most cases (O.S., no. 3, p. 86). In large part, the same racial elements are in both populations, but in different proportions, to which the physical differences are apparently due.

Ainu elements are present in both peoples, and are apparently more strongly represented in the Ryukyus, but even there only in minor proportions (Hulse, O.S., no. 3, p. 7). However, certain areas in Japan itself, exclusive of Hokkaido, show surprising numbers of Ainu-like people (Bishop, '26, p. 567), e.g., Satsuma province in South Kyushu (Baelz, '11, p. 189) and Kozuke, Shimano and Echigo provinces in the mountainous part of Honshu (Bishop, '26, p. 567). Japanese from these provinces would be less easily distinguished from Ryukyuans.

The early Japanese racial element, showing strong affinities with the Southern Mongoloids, is preponderant in both Japanese and Ryukyuans. Hulse (O.S., no. 3, p. 7) states that the greater portion of this element in Ryukyuans is the prime distinguishing feature between them and the Japanese. Von Eickstedt ('34, pp. 213–240–241) calls this type "Palamongolide" and on his *Rassenkarte* shows it as the predominant strain in both populations.

The later racial elements in Japan did not reach the Ryukyus in any number. The Iron Age Yamato people, racially closer to the Northern than the Southern Mongoloids [4] (Hulse, '43, p. 123), apparently entered Japan as a highly civilized minority, and left their stamp racially only as far south as the Inland Sea. If there is substance to the 4 modern Japanese physical types recognized by Hasebe and Matsumoto (see Hulse, '43, p. 123) other racial elements reached Japan as well, but probably had little effect on the Ryukyus.

Within the Ryukyus there is apparently considerable racial variation, although the problem has not been systematically studied. First, there are said to be striking individual variations within each island group. Doederlein (1883, pp. 112–113), an early and apparently accurate observer on Amami O Shima, states that there are 2 physical types there, evenly distributed throughout the island. Large numbers of people apparently represented a mixture of these 2 types. The first, he considers a pure Satsuma Japanese strain. The adult males of the second are very different in appearance. Part of his description of them follows: "Faces are not so broad, and the lower half of the face is very narow; they thus have pointed chins, very rare among true Japanese. Prognathism, frequently marked among the Japanese, does not occur at all [in this type]. Thin lips and noses, and the nasal bridge is only slightly . . . convex, while in Japanese it tends to be concave. Eyes are large and similar to South Europeans. Most striking is the abundant growth of hair. Beards are usually strongly developed and bristly. Only men of the lower class wore long [full] beards; men of higher rank wore mustaches, sometimes a long chin beard. Chest, arms and legs are covered with a thick growth of hair." Doederlein states that there are other differences than physical ones between the 2 types.

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[4] This is the Okayama type, called "Tungide" by von Eickstedt ('33).

Furness (1899, p. 3) and his companion Hiller independently observed the same Ainu-like type in the northern interior of the island. Chamberlain (1895, pp. 317–318) says he did not see any, even among the fishermen, but is not inclined to doubt Doederlein's contention. In all probability an observer today could find a minority of these Ainu-like men among the smooth general mass of the population, but they would be in the isolated interior villages.

Doederlein (1881, p. 153) quotes Perry's descriptions of apparently the same 2 types on Okinawa Jima. Simon ('14, pp. 11–13) adds a description of the Ainu-like type in the Shimazuri district, extreme southern Okinawa.

> ". . . You often see men with an extraordinary growth of . . . beard. Their foreheads are generally high and prominent, the eyes large, deepset, and slightly oblique. The bridge of the nose is narrow without being flat, the tip broad but prominent. They have deep naso-labial grooves, the upper jaw is well-developed, and the mouth large and curved.

They look like Ainu from Hokkaido. . . . But you encounter even more islanders with round faces, less prominent features and not so much hair. They are evidently a mixed type.''

The people in the fishing village of Itoman, Shimazuri district, are said to differ physically, culturally and dialectically from their neighbors (Goldschmidt, '27, p. 195). The frequency of narrow noses, greater stature, and the beauty and independence of the women are sometimes attributed to admixture with shipwrecked Portuguese sailors. Whether these assertions are true cannot be decided. Probably Itoman is distinctive in a cultural sense because of its specialized fishing economy.

Tozzer (O.S., no. 3, p. 7) states that the original racial ingredients which he feels to be Mongoloid, Malay or Indonesian, Korean and Ainu, sort out easily in the Ryukyu population. Murdock (personal communication), who recently saw thousands of Okinawans, disagrees, and says that they intergrade in the same way as other mixed populations.

Second, there are indications of regional variations in physical type in the Ryukyus. Suda ('40, p. 62) states that the peoples of the following island groups represent differing types: Sakishima Gunto, Okinawa Gunto, Amami Gunto, and Osumi Gunto. The proof of this fourfold division may be in the Japanese text, but except for the separateness of the Osumi Gunto series, it is not apparent in the tables. Osumi Gunto people are slightly taller and more brachycephalic than other Ryukyuans and elsewhere (O.S., no. 3, p. 6) it is noted that the inhabitants of Osumi and Tokara Gunto are very similar to the Kyushu Japanese.

The evidence of blood groups and dermatoglyphics suggests that the people of Sakishima Gunto are somewhat different from other Ryukyuans (see this Journal). Haebara ('36, p. 119) alludes to a popular supposition supporting this view. Simon ('14, p. 13) quotes Torii as saying that until the fifteenth and sixteenth centuries, the mountains of Ishigaki Jima were inhabited by Malay people, and that because of their former cannibalism, the people of Yonakuni Jima may be of partly Malay origin. Moreover, the language spoken in Sakishima Gunto is also said to differ as much from Ryukyuan as Ryukyuan does from the Japanese. These indications of isolation can be attributed in part to the political independence of this island group which lasted until the fourteenth century A.D. (Chamberlain, 1895 a, p. 3). The separateness of Okinawa Gunto and Amami Gunto people cannot be confirmed by existing data, although there are dialect differences between the island groups (Chamberlain, 1895, p. 3). In summary, available evidence suggests that racially the most northern Ryukyuans are Japanese, and the South Ryukyus house people rather different from those of the Central Ryukyus. A physical survey of the Central and especially the Southern Ryukyus would be valuable in elucidating these differences among a people directly descended from an early Asiatic maritime stock.

Our present knowledge of the physical characteristics of the Ryuku people, however, is confined to the rather meager literature. These data are summarized below, in hopes that they will stimulate others who have the opportunity to check them first-hand.

Stature

Ryukyuans are short, even shorter than the Japanese (Dixon, '23, p. 292; Suda, '40, p. 62; O.S., no. 3, p. 6) Tables 1 and 2 confirm this, showing that male means for the Central and North Ryukyus range from 157.0 to 159.9 cm. In Japan proper the mean stature of 5,970 males from all 72 provinces is 161.98 cm, with only 4 provincial means below 160 cm (Matsumura, '25, p. 79–88). The mean stature for 1200 Japanese women is 149.92 cm (Matsumura, '25, p. 83), 2.41 cm above that for 932 Okinawan women (M.G.R.C., '45b). Table 3 shows statistically significant differences in mean stature between Ryukyuans and South Kyushu Japanese males measured by the same investigator. These Japanese from Osumi and Satsuma provinces fall in the low stature group even

TABLE 1

Mean measurements (in mm) and indices of Ryukyu males (from Suda).

GROUP	OKINAWA GUNTO	AMAMI GUNTO			OSUMI GUNTO	
ISLAND	Okinawa Jima[1]	Amami O Shima		Kikai Jima	Yaku Jima	Tanaga Shima
INVESTIGATOR	Matsumura	Suda	Kato & Samejima	Miyake & Nakayama	Ito	Ito
Stature (in cm)	(133)[2] 158.05 ± .43	(92) 158.13 ± .50	(72) 158.89 ± .28	(72) 156.97 ± .60	(161) 158.64 ± .45	(269) 159.64 ± .30
Head length	(133) 189.84 ± .47	(92) 189.13 ± .58	(72) 187.72 ± .35	(73) 191.79 ± .78	(162) 187.47 ± .41	(281) 186.54 ± .43
Head breadth	(133) 153.14 ± .43	(92) 153.08 ± .58	(72) 149.89 ± .65	(72) 150.89 ± .63	(162) 152.84 ± .41	(282) 152.04 ± .36
Auricular height	(133) 128.08 ± .50	(92) 131.60 ± .64	(72) 128.37 ± .72	(73) 132.8	(161) 125.19 ± .76	(269) 123.54 ± .65
Morphological facial height	(131) 116.88 ± .47	(92) 121.93 ± .67	....	....	....	....
Maximum facial breadth	(133) 141.79 ± .50	(92) 142.68 ± .50	(72) 138.44 ± .73	....	(163) 142.88 ± .40	(281) 142.91 ± .32
Nasal height	(133) 48.38 ± .31	(92) 51.88 ± .43	....	....	....	....
Nasal breadth	(133) 35.64 ± .19	(92) 36.65 ± .22	....	....	(163) 36.72 ± .26	(282) 38.85 ± .17
Length-breadth index	(133) 80.70 ± .28	(92) 81.03 ± .36	(72) 79.96 ± .41	(73) 78.75 ± .43	(162) 81.52 ± .25	(281) 81.57 ± .24
Length-height index	(133) 67.49 ± .27	(29) 69.64 ± .36	(72) 68.25 ± .44	(73) 68.97 ± .42	(160) 66.47 ± .39	(268) 66.69 ± .37
Breadth-height index	(133) 83.73 ± .37	(92) 86.16 ± .43	(72) 85.56 ± .59	(73) 87.11 ± .55	(160) 81.64 ± .49	(269) 81.74 ± .43
Cephalo-facial index	(133) 92.62 ± .26	(92) 93.30 ± .31	(72) 92.45 ± .53	....	(162) 93.55 ± .27	(281) 93.59 ± .21
Morphological facial index	(131) 82.45 ± .31	(92) 85.36 ± .48	....	....	....	....
Nasal index	(133) 74.09 ± .56	(92) 71.01 ± .71	....	....	....	....

[1] Additional means for 120 Okinawan males are: span, 160.49; shoulder breadth, 37.89; length of arms, 70.43; length of legs (to hip), 79.55 (Suda, '38, p. 90).

[2] Figures in parentheses indicate number of individuals measured.

TABLE 2

Mean measurements (in mm) and indices of Ryukyu females (from Suda).

GROUP	OKINAWA GUNTO	OSUMI GUNTO	
ISLAND	Okinawa Jima	Yaku Shima	Tanaga Shima
INVESTIGATOR	Matsumura	Ito	Ito
Stature (in cm)	(67) 147.79 ± .55	(179) 148.51 ± .36	(245) 148.27 ± .31
Head length	(67) 179.33 ± .72	(181) 180.61 ± .42	(253) 178.42 ± .39
Head breadth	(67) 145.78 ± .55	(181) 147.73 ± .37	(255) 146.40 ± .37
Auricular height	(64) 121.05 ± .71	(179) 121.22 ± .69	(245) 119.26 ± .66
Morphological face height	(64) 108.08 ± .68	....	....
Maximum facial breadth	(64) 133.17 ± .59	(180) 136.61 ± .37	(253) 134.86 ± .34
Nasal height	(64) 44.33 ± .40	....	....
Nasal breadth	(64) 32.86 ± .24	(181) 33.56 ± .19	(256) 35.67 ± .17
Length-breadth index	(67) 81.34 ± .44	(181) 81.89 ± .25	(253) 82.23 ± .22
Length-height index	(64) 67.48 ± .39	(179) 67.24 ± .40	(245) 67.59 ± .40
Breadth-height index	(64) 83.20 ± .53	(179) 82.17 ± .49	(245) 82.19 ± .47
Cephalo-facial index	(64) 91.48 ± .33	(180) 92.52 ± .21	(253) 92.13 ± .21
Morphological facial index	(64) 81.27 ± .50	....	....
Nasal index	(64) 74.88 ± .86	....	....

TABLE 3

Ryukyuans versus Japanese measured by the same investigator. Probable errors of differences between means (calculated from Suda).

	OKINAWA (MATSUMURA)				AMAMI O SHIMA (KATO & SAMEJIMA)	
	Satsuma Prov.		Osumi Prov.		Satsuma	Osumi
	Male	Female	Male	Female	Male	Male
Stature	*6.26*[1]	1.47	*5.36*	1.70	*5.00*	*5.20*
Head length	*4.36*	0.38	1.85	0.42	2.75	1.52
Head breadth	1.86	*3.63*	1.46	*3.52*	1.24	0.92
Auricular height	...	...	...	...	1.06	0.14
Max. facial breadth	...	...	...	...	*3.07*	1.03
Length-breadth index	*5.24*	*5.64*	*3.49*	*4.84*	2.69	1.58
Cephalo-facial index	...	...	...	...	2.12	0.16

[1] Italics indicate 3 × P.E. and above.

among their own people (Matsumura, '25, pl. 10), so that the contrast is actually greater than table 3 indicates. Probably greater Ainu admixture in the Ryukyus lowered the stature there, since mean statures for Ainu males and females are, respectively, 156.6 and 146.8 cm (Koganei, 1894, tables 1–3).

Body build

Generally, Ryukyuans are stockier than Japanese (O.S., no. 3, p. 7). Guillemard (1886, p. 36) says they usually have extremely well-developed chests, and are better proportioned than Japanese since they do not show the long trunks and short legs of the latter. Their shoulders are said to be broad, and the arms short (Suda, '40, p. 62). It is probable that the arms are not relatively short, but only appear so when compared to some long-armed, long-trunked, short-legged Japanese.

In view of their greater Ainu heritage, increased stockiness over the Japanese is highly probable.

Head form

Suda ('40, p. 62) states that mean Ryukyu head lengths and breadths are moderate, and make for high mesocephalic means. According to Dixon ('23, p. 292), Ryukyuans have a much larger dolichocephalic element than the neighboring peoples of Kyushu. In table 3 Matsumura's figures bear this out, while those of Kato and Samejima do not. Elsewhere Matsumura ('25, pl. 4) indicates that Osumi and Satsuma provinces are noted for greater brachcephaly than most others. It is apparent therefore that Ryukyuans cannot be distinguished from most Japanese on the basis of cephalic index. The somewhat greater long-headedness of the Ainu — 77.2 in males, 78.5 in females (Koganei, '25, tables 1–3) — did not apparently carry through in sufficient strength to differentiate Ryukyuans from any but the most brachcephalic Japanese.

Head height

Suda ('40, p. 62) states that the high auricular heights of Ryukyu series make for hypsicephalic mean indices. This is shown in table 1. It would appear that Ryukyuans are at least as high-headed as Japanese and that both peoples exceed the Ainu, but the large personal error in head height determinations precludes further analysis.

Forehead height

Ryukyuans are said to have generally higher foreheads than Japanese (O.S., no. 3, p. 7); Guillemard, 1886, p. 37), and although this observation cannot be verified from present data, their considerable head heights render it probable. Ainu, on the other hand, have lower foreheads than Japanese (Koganei, 1894, p. 282), but apparently this aspect of the Ainu heritage did not carry through in the Ryukyus.

Face form

Table 1 indicates that mean facial breadths of Ryukyu males are moderate, and that morphological facial heights are low on Okinawa Jima and medium on Amami O Shima. This may be only a reflection of personal differences in locating nasion, which in the facial index made for euryprosopy in the first and mesoprosopy in the second. The latter may be more correct for Ryukyuans as a whole and as such would not differ essentially from Japanese. Baelz ('11, p. 188), Guillemard (1886, p. 37) and others have stated that in general Ryukyuans have less prominent cheekbones and less flattened faces than Japanese. On 120 Okinawan males, Suda ('38, p. 92) listed 77.5% "protruding" cheekbones, with the rest "flat." Except for Kato and Samejima's Amami O Shima series, Ryukyuans do not seem to be inferior to Japanese in mean facial breadths. Therefore lateral jut of the cheekbones is probably no less in Ryukyuans. Possibly Baelz and other authors are referring to a reduced anterior jut.

Nose form

Suda ('40, p. 62) states that nasal height is low and nasal breadth is narrow in Ryukyuans. Tables 1 and 2 do not wholly confirm this statement. The nasal height of Matsumura's Okinawa series is low in males and females, but as with facial height, nasion may have been located too low. Suda's Amami O Shima males have a considerably higher mean nasal height, at least as high as in Japanese. Furthermore, there is nothing narrow about the mean nasal breadths. In fact, they approach broadness. Mean nasal indices for the available series are mesorrhine, and probably not different from Japanese.

Guillemard (1886, p. 37) states that in general Ryukyuans have higher nasal roots than Japanese, and Furness (1899, p. 6) notes that the women have flat "but at the same time aquiline noses." That Ryukyuans generally have more prominent noses than Japanese is confirmed by Tozzer (O.S., no. 3, p. 7). The explanation for this may lie in the greater Ainu heritage of the Ryukyuans. Of the Ainu, Koganei (1894, p. 285) says that the nose in males is usually well-formed, with a high nasal root, straight bridge and somewhat compressed alae. Even among broader-nosed Ainu (Montandon, '21, p. 242), the nose is massive and has a bulbous tip.

Eye form

Baelz ('11, p. 188) places Ryukyuan eye form intermediate between Whites and Mongoloids. As in Whites, the eye is usually oriented horizontally, and lies close under rather prominent browridges. Like Mongoloids, the palpebral opening is small. From our own casual observations it is apparent that Baelz overstated the distinctiveness of Ryukyu people. Suda ('38, p. 91) says that 46.2% of the Okinawans observed byMatsumura had horizontal eyes, an observation surely more authorative than Baelz' impressions. If Shapiro's "Sedentes" ('39, table 167, p. 572) are typical of Japanese as a whole, they do not differ greatly in this respect from Okinawans.

In the male "Sedentes" 32% of the eyes are horizontal, 57% oblique and the remaining 11% reversed oblique (internal corner up).

The Mongoloid fold occurred in 74.3% of Matsumura's Okinawans (Suda, '38, p. 92). In the "Sedentes" males, eye folds (internal, median and external) are present in 75.6% (Shapiro, '30, table 167, p. 570). The Mongoloid fold, then may be no less frequent in Ryukyuans than Japanese. Its incidence in Ainu is low (Koganei, 1894, p. 283).

Skin color

Baelz ('11, p. 189) states that Ryukyu skin color is yellowish, but that many have a reddish, vascular tinge to the skin — a feature reasonably frequent in Ainu.[5] Exposure to the sun darkens the skin, and thus as Guillemard (1886, p. 36) notes, the Shi class people are lighter than commoners. Dixon ('23, p. 292) and Tozzer (O.S., no. 3, p. 7) indicate that in general Ryukyu skin color is darker than Japanese. If true, Koganei's (1894, p. 260) assertion that Ainu are generally darker in skin color than Japanese[6] could mean that the greater Ainu heritage of Ryukyuans is indicated in their darker skin color.

Suda ('40, p. 58) gives Matsumura's skin color data for upper arm and forehead of Okinawans, which he converted to the von Luschan scale for comparative purposes. These and other data are summarized in tables 4 and 5. Comparing Ryukyu upper arm color with Shapiro's ('39, table 167, pp. 564, 581) "Sedentes," it is apparent that the Japanese have a lower frequency of the light (7–9), greater frequency of the medium (10–12) and are only surpassed by the Amami O Shima series in incidence of the dark (13–15) shades. Therefore on unexposed skin, Ryukyuans are somewhat lighter. The closest approach to an exact comparison of exposed skin is the Ryukyu forehead against the Japanese "Sedente" cheek color. Here the males show roughly the same distribution, with a somewhat lower incidence of light shades in the Ryukyu females. On this basis it seems likely that Ryukyuans have somewhat lighter unexposed skin color, but that climatic factors darken their exposed skin more than in Japanese.

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[5] Koganei (1894, p. 260) states that some Ainu women show cheek vascularity, but in neither the intensity or frequency found in Japanese women. Montandon ('21, p. 235) says that in Ainu the cheeks are frequently rosy, and in old men cheek colors of von Luschan 3–4 have a bright rosy tinge.

[6] Montandon ('21, p. 235) states that Ainu skin color is not as clear and yellowish as in Japanese, but assumed a duller, more "tarnished" appearance comparable to heavily tanned Central European peasants. On the average, Ainu skin color is a "tanned white." There is some question, therefore, whether Ainu are darker than Japanese on unexposed clean skin surfaces.

TABLE 4

Unexposed (upper arm) skin color of Ryukyu and Japanese males. (von Luschan scale.)

GROUP	OKINAWA JIMA		AMAMI O SHIMA	JAPANESE "SEDENTES"
INVESTIGATOR	Matsumura	Torii	Suda	Shapiro
NUMBER IN SERIES	120	115	92	90
	%	%	%	%
3	...	...	...	2.2
7–9	76.7	97.4	41.8	34.8
10–12	23.3	1.8	45.0	57.6
13–15	...	0.9	14.3	5.4

TABLE 5

Exposed skin color of Okinawans and Japanese (von Luschan scale).

	MALES		FEMALES	
SKIN AREA	Forehead	Cheek	Forehead	Cheek
GROUP	Okinawa Jima	Japanese "Sedentes"	Okinawa Jima	Japanese "Sedentes"
INVESTIGATOR	Matsumura	Shapiro	Matsumura	Shapiro
NUMBER IN SERIES	120	92	29	89
	%	%	%	%
7–9	2.5	0.6	6.9	6.7
10–12	17.5	22.7	17.2	41.6
13–15	71.7	56.4	75.8	42.7
16	8.3	14.0 [1]	...	7.9
18–21	...	6.3	...	1.1

[1] No. 16–17 combined.

It should be noted that the von Luschan scale is poorly equipped for dealing with Asiatic peoples, and its use is still a largely subjective procedure, as witness Hulse's apparently greater sensitivity to the darker tones in the "Sedentes" than was the case for the 3 Japanese investigators. Finally, a cheek-forehead comparison is not wholly valid since the cheek may be lighter and more vascular. Thus the exposed skin color of Japanese may be even darker than Ryukyuans.

Hair form

Baelz ('11, p. 189) could not observe hair form because his subjects were close-cropped, but he judges from reports that wavy hair is seldom seen in the Ryukyus. Yet he notes that long wavy beards are frequent among old men. Suda ('38, p. 92) states that all Matsumura's Okinawan subjects had straight hair. Tozzer (O.S., no. 3, p. 7) on the other hand, states:

> "Whenever one sees any large congregation of Okinawans the hair is the most outstanding characteristic of the group. That on the head is luxurious and . . . usually has a distinct wave or even a curl."

Murdock (personal communication) reinforces Tozzer's opinion, saying that whereas straight hair of Japanese type is predominant, wavy hair is frequently seen in Okinawans. He also indicates that sometimes the hair is of rather fine texture, and in numerous individuals indistinguishable from that of brunette Europeans.

Wavy hair is not unknown in Japanese. Shapiro's "Sedentes" show a total of 19.5% in males for low, medium and deep waves combined. As Tozzer claims, however, the frequency may be considerably greater in Ryukyuans, and as such would be part of their Ainu heritage. In the Ainu, after eliminating 10 close-cropped individuals from Koganei's (1894, pp. 342–376) male series, 52.4% have wavy and 27.4% have curly hair.[7]

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[7] Koganei was careful not to mistake unkempt for wavy hair. Montandon ('21, p. 237) says that wavy hair was general among the Ainu he observed. Buxton ('25, p. 210) adds that Ainu hair "is more or less straight, but the ends are inclined to curl in the men and women."

Hair quantity

The greater hairiness of Ryukyuans compared to Japanese is the most striking difference noted by most observers. Heavier beards are a spot characteristic of the Ainu-like individuals (see p. 122). Matsumura's 120 Okinawan males show the following beard development (Suda, '38, p. 92):

none	2.5%	medium	40.8%
slight	45.8%	heavy	11.7%

Baelz ('11, p. 189) emphasizes the greater bodily hairiness of Ryukyu compared to Japanese recruits in the data presented in table 6. The contrast between his recruits is amazingly large; only 3% Ryukyuans as against 79% Tokyo Japanese were observed as having no hair on the lower leg.

TABLE 6

Body hair of Ryukyu and Japanese males.

	RYUKYUANS			JAPANESE	
GROUP	Okinawa Jima		Amami O Shima	Tokyo	"Sedentes"
INVESTIGATOR	Matsumura [1]	Baelz [2]	Suda [1]	Baelz [2]	Shapiro [2]
NUMBER IN SERIES	120	100	92	100	113
	%	%	%	%	%
Heavy	25.0	30.0	22.8	1.0	0.9
Medium	39.2	47.0	52.2	6.0	3.5
Light	33.3	20.0	25.0	14.0	79.6
None	2.5	3.0	...	79.0	15.9

[1] Observed hairiness of chest, arms and legs. Frequencies therefore not wholly comparable with others.

[2] Observed hairiness of lower leg only.

Shapiro's "Sedente" males are used here as a check against Baelz' Tokyo recruits, and the distributions are very similar in the "heavy," "medium," and combined "light-none" categories. It is likely, however, that many of Baelz' observations of "none" were really "light." Matsumura's and Suda's observations on other Ryukyuans check well with Baelz' figures, especially in view of the fact that the 2 Japanese investigators were considering hairiness of the chest and arms as well. In short, table 6 demonstrates conclusively that Ryukyuans are considerably hairier than Japanese. It is not likely, however, that they often achieve the profuse amount of body hair found in Ainu and some European people. As Hulse (O.S., no. 3, p. 7) says, they "are hairy only in contrast to . . . Japanese." However, the contrast between Ryukyuans and Satsuma province Japanese (Baelz, '11, p. 189) would probably not be great. Both peoples are hairier than most other Japanese, due apparently to greater Ainu admixture.

Blood groups

Since Fink gives a full report of Ryukyuan blood groups (elsewhere in this Journal), the reader is referred there for details. As a group, Ryukyuans differ little from the bulk of Japanese in blood group frequencies. However, the regular decrease of gene frequency of group A from North Kyushu to the Southern Ryukyus suggests greater serological variation in the Ryukyus than heretofore noted. The gene frequency of group B shows no such regular changes, but is higher in the Southern Ryukyus, particularly Yonakuni Jima. Thus both A and B frequencies suggest a separateness of the South Ryukyus, which on the basis of their isolated history seems reasonable enough.

Dermatoglyphics [8]

In the frequency of modal types of palmar main lines, most of the Ryukyu series [9] are intermediate between Ainu and

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[8] Available series:

Ryukyus (913 m and f) — Furuse, '35.
Ryukyus (212 m, 224 f) — Kanaseki, '30.
Ryukyus (?) — Kurishita, '31.
Ryukyus (138 m, 130 f) — Kuwashima, '35.
  North Ryukyus (508 m, 532 f) — Kanaseki and Shima, '38.
    Amami O Shima (322 m, 322 f) — Miyake, '36.
    Kikai Jima (186 m, 210 f) — Miyake and Nakayama, '36.
  Central Ryukyus (847 m, 582 f) — Kanaseki and Shima, '38.
    Itoman (138 m, 130 f) — Hibino, '35.
    Itoman (138 m, 130 f) — Kuwashima, '35.
  South Ryukyus
    Miyako Jima (215 m and f) — Kutsuma and Hukunaga, '39.
    Ishigaki Jima (219 m, 177 f) — Kanaseki and Shima, '38.
    Yonakuni Shima (400 m, 400 f) — Kanaseki, Miyauchi and Wada, '39.

[9] These data were recalculated by us in more detail than in Cummins and Midlo ('43).

Japanese (see Cummins and Midlo, '43, fig. 148 A). This is another clear indication of the greater Ainu heritage in the Ryukyus. In the index of finger pattern intensity (see ibid, fig. 145), both the Ryukyu and Japanese series have higher means than the Ainu, who resemble Whites in their lower pattern intensity. Within the island chain, the Southern Ryukyu series are the most similar in palmar configurations, emphasizing the isolated, provincial character of the people there. On a regional level, however, the North and South Ryukus show greater similarities than either do to the Central Ryukyus.

Twinning

Komai and Fukuoka ('36) present data indicating that dizygotic twinning is significantly more frequent in Okinawa than any other prefecture in Japan. Weinberg's differential method was used on census data and midwives' records to reach this and other conclusions. Since census data from Okinawa prefecture are relatively unreliable (see p. 144), this remains an interesting but decidedly speculative possibility.

THE RYUKYUANS AND WORLD WAR II

While few Japanese and others moved to the Ryukyus, Okinawa prefecture (Okinawa Gunto and Sakishima Gunto) prior to the war contributed substantial numbers of migrants to the industrial areas of Japan. Smaller, but still considerable, numbers immigrated to the Mandates, Philippines, Hawaiian Islands and South America. Apparently the migration of part of its population was an essential factor in maintaining the rural economy of the overcrowded Ryukyus. In Okinawa prefecture alone, the net loss of population by outmigration from 1920–1940 was 193,411.[10] This loss, 98% of the estimated natural increase for the entire 1920–1940 period, and 34% of the total 1920 population, was the heaviest of any of the 47 Japanese prefectures. Taken in 5-year periods, the losses were 63,600 in 1920–1925, 28,331 in 1925–1930, 34,397 in 1930–1935, and 67,083 in 1935–1940. The significance of losses of this size is indicated by the 1930 official statistics on place-of-birth. In that year, 8.1% of all men and 6.2% of all women born in Okinawa prefecture and still resident in Japan, lived in other prefectures. These losses were highly concentrated by age. The percentages of Okinawans outside their prefectures to those still resident there were as follows:

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[10] This figure is in general accord with the higher estimate of 223,413 (C.A.H., p. 55), and is calculated as follows: the net migration is obtained by subtracting the estimated natural increase from the total increase. Since there is gross under-registration of births, numbers were estimated from children aged O enumerated in the census. Deaths were taken as registered, although mortality statistics are also deficient (Taeuber).

	MALES	FEMALES
15–19 years	10%	20%
20–29 years	25%	18%
30–39 years	16%	7%

Since males emigrated in larger numbers, the sex ratio for Okinawa prefecture in 1940 was 112:100 in favor of the females.

Between the regular quinquennial census of October 1, 1940, and the special census of February 22, 1944, the population of Okinawa prefecture increased from 574,490 to 590,480,[11] with the sex ratio rising to 122:100. Whereas the males, excluding conscripts called up in 1940 and before, decreased from 270,654 to 265,530, the females increased by 21,094. Since 14,177 of this increase was in the 15–20 year age group, it is apparent that young women were not heavily recruited for the war plants of the Empire until after early 1944 when the Japanese military position began to disintegrate. Assuming that the natural increase of males was proportional to that of females from 1940–1944, the male population, including conscripts, would have been 289,421 in 1944. The difference between this figure and the actual male population at that time should equal the number of conscripts and civilian male emigrants in the 1940–1944 period. This subtraction product of

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[11] The 1940 census included Ryukyuans in military service outside of Japan proper, whereas the 1944 census considered only Ryukyuan, Japanese, Korean and Formosan civilians and a small number of the armed forces living outside military or naval establishments.

18,787 is consistent with Bennett's ('46, p. 264) estimate of 15,000 conscripts called up on Okinawa Jima between 1940 and October, 1944. These conscripts were shipped to the Mandated Islands, Netherlands East Indies, Manchuria and other war zones, and thereby missed the shattering invasion of the Ryukyus.

Between February, 1944, and the Ryukyu campaign, out-movements of conscripts, civilian war workers and refugees continued until U. S. air attacks largely paralyzed shipping in the Ryukyus. Estimates of the total number leaving the Ryukyus in this period are not available, but 120,000 may not be too high a guess. It is known (Naval M.G. Activities, 1 July, '46, p. 6) that after the heavy October 10 air strike in 1944, some 70,000 refugees from Naha and other bombed-out towns in Okinawa Jima left for Japan, lodging mostly in Kagoshima. The 1944 class of 20–21 year old conscripts numbered roughly 5,000, to which should be added the older men removed from the Ryukyus for labor service in that year. The recruiting of war-workers, especially young women, for Japanese war plants must have increased in 1944. Possibly 30,000 is not far from the actual number. In 1945, prior to the invasion, all remaining able-bodied men were taken into the Imperial Japanese Army, the Boie Tai (Home Guard Force) or the Gonzuko (Labor Battalion). Bennett ('46, p. 264) estimates this number to be about 30,000 for Okinawa Jima alone. Presumably most of these remained on Okinawa.

The full catastrophic effect of a shooting invasion was felt only on Okinawa Jima. There some pre-invasion shifting of the population was apparent, since it was apparently Japanese policy to move many of the civilians north of the heavily populated southern third of the island. By April 1, Bennett ('46, p. 264) estimates that over three-quarters of the people were in the north and central portions of the island. The Okinawan men in the Boie Tai and Gonzuko, however, followed the Japanese troops south to the area elected for defense. Ordinarily their families went with them, and were also caught in the bitter fighting. Some were killed or captured, others died from privations, but a considerable number were able to cross U. S. lines and enter the villages and MG camps. Some were shot trying to do it (for 1 of many instances, see Moloney, '45, pp. 397–398).

The Okinawan civilians who did not retreat south with the Japanese troops undoubtedly fared better. Most of them took to the hills and hid out in caves until brought out by U. S. forces. In large part, these were the children, middle-aged and elderly people.

The Okinawan men in uniform surrendered in greater numbers than the Japanese. Anecdotal material (Moloney, '45, p. 297) indicates that suicide in the face of hopeless odds was not part of Okinawan psychology. Murdock (personal communication) visited the Ishikawa POW camp in August, 1945, and states that there Okinawans greatly outnumbered the Japanese. Many others managed to sneak into the MG camps and fade into civilian population. Some of these were screened out by the U. S. Counter Intelligence Corps and MG Public Safety officers, and transferred to POW camps. Bennett ('46, p. 264) states that Okinawans in the Japanese Army or Boie Tai can probably be written off, and that perhaps only 5,000 got through the lines and survived. Certainly more than that lived through the invasion, but exact figures are not available. Murdock's (personal communication) impression was that the Ishikawa POW camp held perhaps 6,000 Okinawans in August. He hazards a guess that of those with the Japanese forces, roughly 15,000 survived.

It is impossible to calculate the civilian casualties on Okinawa Jima resulting from the invasion, since the number of civilians on D-day can only be hazarded. As a guess, possibly 96,000 (70,000 refugees, about 26,000 war workers and conscripts in 1944) left Okinawa Jima before the invasion. This would reduce the population to about 352,000, including the estimated 30,000 Okinawan men with the Japanese forces. During the battle civilian refugees streamed into the MG camps. During April 126,000 were taken in, with 110,000 following in June, the month yielding the next largest contingent

(Naval MG Activities, 1 July, '46, p. 6). On July 12, the total number of Okinawans in MG camps was about 265,000 (Bennett, '46, p. 264). Stragglers raised this total to 300,000 in August (Naval MG Activities, 1, July, '46, p. 7). Of these, 250,000 were miserably settled north of the Ishikawa-Nakadamari highway and the remaining 50,000 were comparatively well off in the Koza and Chinen areas. In addition, a few thousand more men were in the POW camps. On the basis of these estimates, the total casualties from April to August should be around 46,000. Bennett ('46, p. 264) felt that 75,000–100,000 Okinawans remained unaccounted for, but he did not have all the figures used here.

TABLE 7

Population of Okinawa Jima, 1940–45, by age and sex.

AGE	MALES Oct. 1940 [1]	MALES Feb. 1944 [2]	MALES July 1945 [3]	FEMALES Oct. 1940 [1]	FEMALES Feb. 1944 [2]	FEMALES July 1945 [3]
0–19	52.4%	55.2%	58.9%	45.4%	44.5%	43.0%
20–44	26.1%	21.4%	7.5%	29.0%	29.4%	26.0%
45–x	21.5%	23.6%	33.5%	25.4%	26.1%	31.7%
Population	202,874	199,176	114,120 [4]	232,807	250,032	185,910 [4]

[1] Japan: Census, '40 (Western ages).

[2] Japan: Special census, '44 (Japanese ages minus 1 year).

[3] MG Hq population data, '45 (Japanese ages minus 1 year).

[4] Estimated.

Sex and age composition of the surviving civilian population on Okinawa can be estimated from data for 18,682 persons in MG Detachments C-2 and C-18x in July, 1945. Of these, 38.04% were male, 61.96% female, giving a sex ratio of 163 : 100. Addition of the men in POW camps would reduce this ratio to around 155 : 100.

The age composition is listed by sex in table 7. If the age distribution of this sample is applied to the total civilian population of 300,000 it indicates that only about 8,500 men between the ages of 20 and 44 were in the MG camps at the campaign's end. Addition of POW's would raise this figure to a guess total of some 15,000. In February, 1944, there were over 42,000 men, exclusive of previous conscripts, in this age group. Some of these men left Okinawa before the invasion. Probably the war casualties among these able-bodied men were not far from 15,000–20,000.

The age composition of the sample indicates reductions in all age groups save the elderly. If our estimates of about 46,000 total casualties, including 15,000–20,000 among the able-bodied men, are approximately correct, then there were roughly 30,000 casualties among the other age groups. Up to July 12, 1945, the elderly suffered the smallest losses, presumably because they stayed nearer home and were caught in less actual fighting. Children suffered heavy losses, beginning with the U. S. air attacks and consequent civilian dislocation. Infant mortality was very high. In this connection, Moloney ('45, p. 393) states:

> "because of the psychological inhibition of fear on lactation the breasts of a great many [Okinawan] mothers became dry during the days of the fierce bombardment. Consequently a large number of babies starved to death. Others were seen in varying stages of inanition."

Emory ('45, p. 616) discusses the malnutrition and undernutrition of Okinawan children following the invasion, noting that they were worse in those under 6 years of age. This, he says, was especially true for those under 4 who could not forage for themselves. But breast-fed children suffered the most, since due to the mother's inadequate nutrition, both quantity and quality of the milk was low.

The invasion and its aftermath brought island-wide disruption to the Okinawans.[12] At least 75% of the people were displaced from their home area, and 90% of their homes and buildings were destroyed. After lodging in the MG camps, the Okinawans were then shuttled into collection centers and transported north to the relatively barren Kunigami district. There they overwhelmed the local inhabitants and all suffered great privations, despite the efforts of U. S. personnel to properly feed, clothe,[13] and house [14] them. The problem can be seen from the following figures: whereas in June, 1945, only 22% of the food consumed in the MG camps was U. S. rations, by early fall, 75% of it was supplied by the U. S. Since U. S. rations had to be imported, and shipping space was meager then, MG camp rations had to be halved in the critical period from September 27 to October 24, 1945.

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[12] Much of the following information was derived from Naval MG Activities, 1 July, '46.

By late October, however, about 2,000 had been moved back to their home areas. By June 1, 1946, some 138,000 had been resettled, leaving 125,000 still displaced as of July 1. In July, however, the DP figure was reduced to 68,000 (Army MG, November, '46, p. 47).

Repatriation of Okinawans from other areas began in early 1946. Between the end of January and April 16, 29,809 Okinawans returned home from the Mandated Islands. Some thousands of Okinawans from Formosa reached the Southern Ryukyus. Small craft brought several hundred more home to Okinawa from the other Ryukyus.

The military government of the Ryukyus changed hands from the U. S. Navy to the Army on July 1, 1946. As of that date, the Navy summarized the Ryukyu population under MG control (see table 8).

No full break-down of the Ryukyu population by sex and age is available in the reports at our disposal, but the U. S. Navy (Naval MG Activities, 1 July 1946) published the following figures on age composition. As of July 1, 1946, 40% was in the 1–15 year (Japanese) age group. The Okinawa sample of July, 1945, shows 43.5%, the special census of February 22, 1944, 39.3%. It is apparent that even by July, 1946, repatriation of adults was sufficient to restore the proportion of children in the population to normal. The same is not true for the men between the Japanese ages of 21 and 50, who numbered only 29,000 on July 1, 1946. This is only

[13] Issue of GI clothing by months in 1945: 85,000 pieces in October; 85,000 in November; 625,000 in December and decreasing thereafter. 40,000 blankets issued before the coldest weather set in.

[14] By July 1, 1946, 18,602 small homes had been constructed, 48.5% from salvaged Okinawan materials.

7.2% of the population as contrasted to 14.5 and 11.8%, respectively in the 1940 and 1944 censuses. The replacement of able-bodied men lost during the invasion will apparently take a longer time.

After Military Government of the U. S. Army took over the Ryukyus, monthly population figures were published (Army M.G., Nov. '46, p. 51). These are reproduced in table 9 and show the repatriation rate. There is over 45,340 difference between the Army and Navy figures for the population as of June 30–July 1, 1946. No reason is given in the Army's report for this discrepancy, nor can we proffer a full explanation. It is possible that the Navy report included Japanese, Koreans and Formosans, whereas the Army report did not. The most important feature of table 9, however, is that by Novem-

TABLE 8

Population of the Ryukyus, 1940–47, by area.

	OCT. 1, 1940 [1]	FEB. 22, 1944 [2]	JULY 1, 1946 [3]	MARCH 1. 1947 [4]
North Ryukyus	264,870	268,539	226,500	211,057
Central Ryukyus	469,922	484,128	401,500	510,462 [5]
Daito Shoto	5,844	6,000	2,500	
South Ryukyus	98,813	98,352	105,000	111,555
Total Ryukyus	839,449	857,019	735,500	833,074

[1] Japan: Census, '40.

[2] Japan: Special census, '44.

[3] Naval MG Activities, 1 July, 1946.

[4] Army MG unclassified information.

[5] Includes Daito Shoto.

TABLE 9

Population of the Ryukyus in 1946–47.

June 30, 1946	690,160
July	692,407
August	700,086
September	727,695
October	769,367
November	817,160
March 1, 1947	833,074

ber 30, 1946, repatriation brought the population up to within 40,000 of its early 1944 level. As of that date, almost that number still remained to be repatriated. The March 1, 1947, population was within only 24,000 of the 1944 figure.

The repatriation figures are of interest here since they evidence a reversal of the heavy continuous out-migration before and during the war.[15] Between July 1 and Nov. 30, 1946, 88,766 Okinawans were repatriated from Japan, 5,609 from Formosa, 319 from the Marianas and 431 from Hawaii. The over-all repatriation of Ryukyuans is given in table 10. From these figures it is apparent that the completion of repatriation would leave a total of 853,880 [16] in the Ryukyus, more than recorded in the 1940 census and almost as many as in early 1944. This means that far from having its population decimated by the war, the Ryukyus are just as overcrowded as they ever were. On Okinawa Jima the crowding is probably greater. In November, 1946, half of the arable land was still

TABLE 10

Repatriation of Ryukyuans, status as of November 30, 1946.

	REPATRIATED	TO BE REPATRIATED
From Japan	142,713	31,860
Pacific Islands	26,003	198
Formosa	12,154	4,662
Hawaii	1,954	.....
Korea	253	.....
Total	183,077	36,720

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[15] Much of the following information was derived from Army MG, Nov. '46.

[16] This figure represents wholly native-born Ryukyuans, since all others have been removed from the island chain. On Nov. 30, 1946 (Army MG, Nov. '46, p. 49), their status of repatriation was as follows:

	REPATRIATED	TO BE REPATRIATED
To Japan	57,345	3,706
To Korea	1,755	....
To Formosa	21	....
Total	59,121	3,706

used by U. S. forces. This will be reduced in 1947, but some thousands of acres are estimated to be irreclaimable to cultivation for years if not forever (Naval MG Activities, 1 July 1946, p. 8). If the natural rate of increase in Ryukyuans reaches the heights of 1920–40, outmovement will have to start again.

During the war years from 1940–1944, the Ryukyu birth rate apparently declined. Between the 1940 and 1944 censuses, there was a decrease in the number of children under 5 years of age.[17] The registration of children under 1 year (Western) in 1940, 1944 and 1945 (Okinawa population sample) indicate a decline in the birthrate, providing the bias in these registrations can be assumed constant.[18] During the war years through 1943, Japan, like the U. S., experienced an increased birth rate, but this was the net result of urban increases, despite continued decreases in rural rates (Taeuber). The falling wartime birth rate of the rural Ryukyus is consistent with those of other rural areas in the Japanese empire.

Vital statistics for Ryukyuans from the time of the invasion to the present are meager, but fuller accounts may lie in the MG files. The death rate among Okinawans in the MG camps was very high, possibly as much as 5 times greater than in peace time, although this cannot be verified. An example of the meager evidence will suffice: For a 10-day period from April 12 to 21 at Camp C-2 when the population was stabilized at 10,785, 30 died from inanition and cold alone, and several more were shot "out of bounds."[19] (MG Detachment C-2, '45). It is not until August, 1946, that monthly vital statistics were collected and published (Army MG, Nov. '46, p. 51). These are reproduced in table 11.

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[17] A relatively small fraction of this decrease is an artefact, since the 1940 census reported Western ages, the 1944 census Japanese. In the latter system, a baby is 1 year old at birth, picks up another year the following January 1. Thus a baby born on January 1 does not become 2 years old for a year. A baby born December 31 becomes 2 years old the next day. The maximum difference between Western and Japanese ages is 2 years, the minimum 1, the average 1½. The MG population estimate only subtracted 1 year from Japanese to convert to Western. We have had to employ this minimum conversion, since we do not have the year-by-year break-down for these estimates.

Parenthetically, if one wishes to determine Western age of Japanese, do not ask "How old are you?" but "When were you born?" The regular quinquennial Japanese census of 1920 to 1940 asked for date of birth; the special census of 1944 and 1945 (Ryukyus not reported) asked for age.

[18] A comparison of children aged 0 and recorded births indicates that at least ⅕ of all births in Okinawa prefecture escape registration in the year in which they occur. Deaths are patently under-registered, especially those of infants, and cause-of-death statistics are grossly deficient (Taeuber).

Table 11 presents a clear case of gross underregistration in birth, stillbirths and deaths. One example will suffice. The death rate per 1000 for Okinawa prefecture in 1938 was 16.1, more than 3 times the hypothetical annual rate taken from November figures in table 11. One would expect the 1946 death rate to exceed that of 1938, in view of the war's disrupting effect. Parenthetically the 1938 death rate itself is probably low due to underregistration. Table 11 is useful only in indicating a rise in birth rate, and a decline in stillbirths, providing the bias of the registration is constant.

TABLE 11

Vital statistics on Ryukyuans, 1946.

	BIRTHS		STILL BIRTHS		DEATHS	
	no.	rate [1]	no.	rate	no.	rate
August	261	3.73	14	0.20	250	3.57
September	354	4.86	9	0.12	314	4.31
October	471	6.12	4	0.05	362	4.70
November	615	7.53 [2]	5	0.06	356	4.36 [2]

[1] per 10,000.

[2] Converts into hypothetical annual birth and death rates of respectively 9.01 and 5.23 per 1000.

In summary, although the Ryukyus suffered over 50,000 casualities directly due to World War II, recent repatriation has more than made up the losses in numbers, but able-bodied young men may be less numerous than before. Since, however, there will be less available arable land on Okinawa Jima for some time to come, there will be no labor shortage. The immediate future of the islands will depend upon speedy re-establishment of cash crops and local food supply, and on out-movement to absorb population surplus.

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[19] This implies no negligence on the part of the Military Government. Many Okinawans entered the camps in starved condition and were too far gone to recover. Because of infiltrating Japanese troops, night sentries were forced to "shoot first and ask questions afterward."

NOTES ON THE POST INVASION PHYSICAL STATUS OF THE OKINAWANS

During June and early July, 1945, the Military Government Research Center measured stature and weight of 6391 Okinawans for the purpose of estimating their minimum nutritional requirements. Of these 56 were newborn, the others ranging in age from 1 to 80 years. The age distribution of this sample is similar to that of the Military Government estimate except that fewer children below 4 years and adults above 45 years, but many more in the 10–14-year group were measured. Island-wide distribution of subjects resulted from the unselective and arbitrary assignment of natives to Militarl Government camps in the north. Subjects were weighed fully clothed on a Japanese beam-balance scale that had been corrected with objects of known weight. Since measuring was done during warm weather, clothing was light. Stature was measured on a calibrated standard attached to a platform upon which subjects stood. A right-angle slide attached to the standard was brought down to the top of the subject's head. Sandals were worn during measurement.[20] Infant stature was measured horizontally by tape measure.

The Okinawans making up the Military Government series were undoubtedly debilitated by the invasion. On the other hand, the most sick and feeble were probably not measured. Thus the MG series represents the better-than-average in physical condition, although those measured in July may have been pulled down by the exhausting trek to the northern part of the island where MG relocated most of the civilian camps.

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[20] Compensations for age, weight of clothing and thickness of sandals should be made to render this study comparable to those on non-Japanese. To accomplish this, 1½ years should be subtracted to approximate Western ages. One kilogram for clothing weight and 0.5 cm for sandal thickness should also be deducted. In comparing Okinawans with Japanese (tables 11 and 12) it is preferable to use Japanese ages and uncompensated stature and weight.

A review of recent environmental factors is pertinent here since nutritional status directly affects stature and weight for pre-adults and weight thereafter. During the war, the Japanese increased their levies of foodstuffs and rationed rice at $\frac{1}{3}$ cup daily per person on Okinawa. Sweet potatoes were the principal food, while meat reached the average family about 4 times a year and milk was seldom served (Bier, '45). Yet when questioned early in April (MGD B-6, 30 April, '45) 94% of an opinion sample indicated that they got enough to eat under the Japanese. Whereas the Japanese conscripted the best food just before the invasion, the Camp C-2 inventories of salvaged food[21] from the Shimabuku area, and examination of abandoned residences by Camp B-6 salvage crews indicate that some Okinawans had plenty of food. Some of the hideout caves used by Okinawans during the invasion were well-provisioned, and their occupants suffered only from overcrowding and poor sanitary conditions. Others virtually starved before they reached the MG camps. If generalizations can be made, it seems likely that until the MG camps were moved north out of the fertile but picked-over southern part of the island, most Okinawans were fed enough to sustain life.[22] It was a common observation, however, that fat Okinawans were never encountered, and that emaciation, while not the average condition, was common enough. Also disease bears directly upon Okinawan physical status. Benjamin ('46, p. 497) found about 50% of his autopsy sample to carry hookworm or ascaris or both, whereas Fink estimated similar infestation in over 90% of the population. Furthermore filariasis infected at least half the people (Moloney, '45, p. 392).

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[21] Inventory of April 15 (MG Detachment C-2 War Diary) to feed about 10,000 people: 585 bags beans, 346 bags rice, 38 tubs sugar, 25 boxes fish, 182 boxes cakes, 60 boxes seaweed, 173 bags flour, 200 boxes soup preparation, 18 bags sugar, 194 boxes spaghetti, 280 boxes dried cabbage, 14 boxes bread, 77 bags salt, 25 boxes tea. This was augmented by almost daily collections of non-perishable food until the area was cleaned up about May 17. Native salvage of fresh vegetables from neighboring fields was started on April 6 and continued during clement weather whenever MP guards could be provided. The lack of MP s caused a decrease in rations so that on May 18 the Ku-heads complained that 5 days ration was only enough for 1 day. As a result the ration was doubled. No military stores were used for Okinawan consumption through May 31, but early in June, U. S. foodstuffs were used to supplement native diet. Late in July, after the move north, daily rations of milk for children up to 5 years were inaugurated. For a description of similar rationing see Emory ('45).

This background of physical hardship should be reflected in the MG stature-weight figures, even though probably only the most healthy were measured. Compared with Japanese series of the same ages, the differences are not as great as might be expected. When compared to Ito's ('36) Japan-born series, the measurements of Okinawan newborn are less only in body weight. The heaviest Japanese series exceeds the Okinawans by 170 gm in males, 250 gm in females.

For comparison with the MG age series, 3 Japanese series from Honshu are used in tables 13 and 14. The Yamagata province series was measured in time of peace; the Akita and Mizusawa series[23] in wartime. The children of the Mizusawa

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[23] The caloric intake for Okinawans in MG camps was established (Cinc Pac Serial ltr. C 4933, 5 June 1945) as follows:

0–1 year (Western)	782 calories
1–2 years	921 calories
2–4 years	1116 calories
5 years and over	1530 calories

This was elaborated July 25, 1946 to read:

Unemployed, 4 years and over, 1530
15 years and older, engaged in light and moderately heavy labor, 2200
Pregnant and lactating women, 2200
15 years and older, engaged in heavy manual labor, 3000

In practice, these caloric standards were achieved only when sufficient food stores were available, distribution through the Ku-heads was wholly equitable, and people ate the food as issued. Often they would trade high calorie food for something of lower caloric content which they liked better.

[23] The last 2 series were made available by Dr. F. S. Hulse who procured them in Japan in 1945.

National School had been weighed yearly since 1937 and show only a slight diminution in mean weight of 12–14-year-olds during the war years. Dr. Hulse tells us that in the fall of 1945, undernutrition and malnutrition in Japan were apparently not sufficient to devitalize the people, but that Dr. Suzuki, school physician at Mizusawa, was alarmed at the resulting poor health of many of the children. From a survey of Japan during the summer of 1946, Dr. Gordon Bowles states[24] that the cumulative effect of inadequate nutrition was adding to the poor health of the Japanese, and that the rates of tuberculosis and children's diseases rose sharply.

TABLE 12

Measurements of Okinawan newborn in June–July, 1945.

SEX	NO.	HEIGHT	WEIGHT	HEAD CIRCUMFERENCE	CHEST CIRCUMFERENCE
		(cm)	*(gm)*	*(cm)*	*(cm)*
Male	32	49.6	2890	33.7	31.5
Female	24	48.8	2700	33.0	30.6

Thus the nutritional status of Okinawans and Japanese in early 1945 was much the same, although the latter did not suffer the catastrophic effects of a shooting invasion.

With almost complete consistency, tables 9 and 10 show that age for age, the Okinawans are shorter and lighter than the Japanese. The adult Japanese series are several cm taller than the Okinawans and this makes for larger differences in the age series from 14 years on. The differences in weight are even greater above 14 years, suggesting that during the last of the growth period, Okinawans lacked adequate diet to sustain their weight.

Mean adult stature for 134 Okinawan men (MG Height-Weight Study) of 21–40 years is 152.45 cm, an exceedingly low figure attributable to the selection of larger men for the Japanese army. Their mean weight was 52.39 kg. Means for

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[24] In a lecture on "The impact of the war upon the Japanese people" given November 19, 1946, before the Anthropological Society of Washington.

TABLE 13

Stature of Ryukyuans and Japanese by age.

JAPANESE AGE	MALES						FEMALES					
	Ryukyuans		Japanese				Ryukyuans		Japanese			
	Okinawa (1945)[1] no.	mean	Yamagata (1930)[2] no.	mean	Akita (1944)[3] no.	mean	Okinawa (1945) no.	mean	Yamagata (1930) no.	mean	Akita (1944) no.	mean
3	33	74.90					21	73.48				
4	78	83.90					44	83.13				
5	76	90.60					66	89.97				
6	87	94.56					81	97.16				
7	107	102.39			c. 700	108.70	89	100.10			c. 700	108.10
8	144	101.89			700	114.57	141	105.21			700	113.00
9	141	109.58	c. 42,000	118.7	700	118.80	132	112.01	c. 42,000	117.2	700	118.10
10	224	116.54	42,000	122.2	700	124.13	187	115.98	42,000	120.9	700	123.30
11	258	120.88	42 000	126.6	700	129.06	172	121.29	42,000	125.5	700	127.50
12	266	126.14	42,000	130.8	700	133.06	193	123.57	42,000	130.8	700	135.00
13	160	129.41	42,000	135.4	700	137.33	144	128.40	42,000	136.4	700	137.40
14	148	135.48	42,000	141.2	700	143.65	89	133.99	42,000	142.4	700	142.50
15	125	135.94	42,000	147.3			83	136.88	42,000	146.4		
16	51	142.25	42,000	155.7			65	142.60	42,000	150.2		
17	39	143.15	42,000	159.8			45	145.47	42,000	150.9		
18	9	151.97	42,000	161.5			55	145.47	42,000	151.2		
19	8	150.72	42,000	162.0			27	144.37	42,000	150.8		
20	9	152.20	42,000	162.6			73	147.32	42,000			
21	5	149.37	42,000	162.1[4]			77	147.55	42,000			
Total	1978		c. 550,000		c. 5,600		1785		c. 550,000		c. 5,600	

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[1] Date measured.

[2] From Takahashi, '31–'32.

[3] Hulse, personal communication.

[4] 21–24 years.

TABLE 14

Weight (in kg) of Ryukyuans and Japanese by age.

JAPANESE AGE	RYUKYUANS		JAPANESE					
	Okinawa (1945)		Yamagata (1930)[1]		Akita (1944)[2]		Mizusawa (1945)[2]	
	no.	mean	no.	mean	no.	mean	no.	mean
				Males				
3	33	9.95						
4	78	11.66						
5	76	13.51						
6	87	14.56						
7	107	16.88			c. 700	17.60	176	18.2
8	144	18.96			700	19.51	215	19.4
9	141	19.92	c. 42,000	22.5	700	21.84	194	21.3
10	224	21.80	42,000	24.1	700	23.38	220	23.9
11	258	25.16	42,000	26.2	700	27.11	224	26.1
12	266	26.88	42,000	28.5	700	29.07	201	27.9
13	160	29.10	42,000	31.3	700	30.48	191	30.9
14	148	33.62	42,000	35.2	700	36.46	143	33.2
15	125	35.15	42,000	39.9				
16	51	38.34	42,000	47.0				
17	39	44.49	42,000	51.4				
18	19	45.42	42,000	54.1				
19	8	44.15	42,000	56.6				
20	9	49.82	42,000	57.3				
21	5	43.20	42,000	57.4 [3]				
Total	1978		c. 550,000		c. 5,600		1,564	
				Females				
3	21	9.58						
4	44	11.67						
5	66	13.01						
6	81	14.94						
7	89	15.55			c. 700	17.40	175	17.7
8	141	17.83			700	19.20	195	19.1
9	132	20.98	c. 42,000	21.5	700	20.80	197	20.3
10	187	22.65	42,000	23.1	700	23.40	229	23.7
11	173	25.63	42,000	25.4	700	26.80	227	25.9
12	193	26.03	42,000	28.2	700	29.90	180	28.3
13	144	28.95	42,000	32.1	700	32.10	132	31.4
14	89	32.74	42,000	37.0	700	35.40	116	34.4
15	83	36.66	42,000	41.0				
16	65	38.26	42,000	45.9				
17	45	42.94	42,000	48.3				
18	55	44.74	42,000	49.4				
19	27	49.45	42,000	50.7				
20	73	47.53	42,000					
21	77	47.53						
Total	1785		c. 550,000		c. 5,600		1,453	

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[1] From Takahashi, '31–'32.

[2] Hulse, personal communication. Mizusawa series measured by Dr. J. Suzuki, school physician, in April, 1944.

[3] 21–24 years.

932 females are 147.51 cm and 46.55 kg. The male means are substantially lower than in Japanese, especially in stature. The Okinawan females show less diminution in stature and weight than the males. Adults of both sexes are shorter and lighter than the Japanese, but diminution of body weight consistent with their recent hardships is not apparent. The extremely low incidence of psychoses in view of these hardships and the actual traumata of the invasion (Moloney, '45) is another indication that hardy people living close to the subsistence level show amazing resistance. Whether heavier physical and psychological reactions will crop out later is a problem for further research.

SUMMARY

It is probable that the first inhabitants of the Ryukyus were Ainu-like people from the main Japanese islands. In the first or second millenium B.C., Southern Mongoloid people entered Japan, presumably via Korea, and pushed south to the Ryukyus where they outnumbered the Ainu. There is no evidence that later arrivals in Japan proper affected the Ryukyus. Chinese and Japanese contact with the island chain dates to the seventh century A.D. From 1372 to 1871 Chinese cultural influence was heavy, and Ryukyu kings paid tribute to the Chinese court. Tribute was also paid to the Japanese from 1451 on, but apparently cultural and racial influences from that source were heavily felt only in the Northern Ryukyus. In 1871, Japan formally annexed the islands.

Neither the Chinese nor the Japanese attempted to colonize the Ryukyus, whose meager resources attracted few immigrants. Some settled as traders, administrators and teachers in the main cities, and minor admixtures took place there. The presence of Japanese garrisons in 1875 and again in 1944–1945 also made for some admixture. However, no ethnic minority of any importance exists in the Central and Southern Ryukyus, and even intermarriage with Japanese is rare. The rural people who constitute over three-quarters of the population have been virtually without foreign admixture in historic times.

For the most part, Ryukyuans and Japanese have the same racial elements, but the differences in their proportions make it possible for experienced observer to distinguish many of the 2 peoples. Ryukyuans have higher proportions of Ainu and Southern Mongoloid than the Japanese themselves, and apparently lack much of the Northern Mongoloid strains later entering Japan. The greater Ainu heritage of the Ryukyuans is apparent in most differences they show relative to Japanese. A minority of males from Amami O Shima and Okinawa Jima are said to be very much like Ainus. In general Ryukyuans are shorter and stockier, with less prominent cheekbones, more prominent noses, lighter unexposed skin color, more frequently wavy hair, and more abundant body hair. In their palmar patterns, most Ryukyu series lie intermediate between Ainu and Japanese.

Within the Ryukyus, there is some evidence of local differences. The people of Osumi and Tokara Gunto in the North are closely akin physically and linguistically to neighboring Kyushu Japanese. The regular decrease in gene frequency of blood group A from North Kyushu to the South Ryukyus suggests there may be other physical differences as well. In their unusual gene frequencies — low A and high B — the people of the South Ryukyus stand apart from their neighbors. This separateness is reinforced by dermatoglyphics, and presumably was made possible by the political isolation of that island group. Lacking data to the contrary, the centrally located Ryukyuans of Okinawa and Amami Gunto are considered central in physical type.

Before World War II, out-movement of Ryukyuans especially from Okinawa prefecture was essential to the maintenance of the rural economy of the crowded islands. During the war this out-movement continued, mostly as recruits for the Japanese Army and war workers for the Empire's factories. It was accelerated in late 1944 and early 1945 by refugees from the U. S. air strikes. Thus upon the invasion of Okinawa, April 1, 1945, the civilian population of the Ryukyus had decreased by about one quarter from its early 1944 level. Selected target areas of the larger Ryukyu Islands drew bombing and shelling from U. S. and British forces, but in addition Okinawa Jima was the scene of bitter land fighting. As a result, Okinawan casualities were in the neighborhood of 10% of the 1944 civilian population. Able-bodied men and infants suffered the highest proportional losses. The survivors were crowded in MG camps, and suffered considerably until resettled in their home areas. Repatriation of Ryukyuans from Japan, the Pacific Islands, Formosa, Hawaii and Korea was virtually complete by the first of 1947. This leaves the present native Ryukyu population greater, if anything, than the 1940 and 1944 levels. Coupled with this, the reduction of arable land available to Okinawan farmers may soon demand a continuation of out-movement to balance the resources of the island chain.

The surviving Okinawans apparently did not suffer a loss of body weight consistent with their recent hardships. 6,391 Okinawans of all ages measured by MG in June and early July, 1945, have shorter stature but not excessively lower weight than comparable Japanese. Seemingly their reduced wartime nutrition, high incidence of intestinal parasites and filariasis, overcrowding and poor sanitation in hide-out caves, and the traumata of the invasion itself, did not cause the excessive emaciation and widespread psychoses which might be expected. This indicates unusual physical and psychological stamina. But their future health is uncertain. The cumulative effects of inadequate nutrition and other hardships may result in lowered health for Okinawa and the other Ryukyu Islands as it has in Japan itself.

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PROF. EGON FRHR. VON EICKSTEDT, formerly director of the anthropological institute of the university of Breslau and editor of the *Zeitschrift für Rassenkunde*, has been appointed director of a *Forschungsinstitut für Menschenkunde* at the newly established Johannes Gutenberg Universität in Mainz, Germany. From a recent letter to A. H. Schultz the following excerpts are here quoted in free translation:

“With these lines I am trying to resume our former professional relations. Unfortunately this cannot be done by sending you my reprints from the last few years, which were quite numerous, because they were lost, together with all my personal possessions, my institute and the entire material from my many years of tropical expeditions. The only thing still available (in very limited number) is my East-Asia book which had appeared a few weeks before the ‘collapse’ and which is known so far to only a few experts on East Asia. It comprises the bio-historical results of my expeditions and it remains the only larger work dealing with my investigations, since the planned series of volumes on the peoples of Asia cannot be issued. The book referred to contains 658 pages, several hundred illustrations, a great many maps, etc. and I may dare to offer it as an exchange, because somehow I must try to obtain again some literature. I am now engaged in trying to create an institute, but for scientific work and for the students there exists as yet next to nothing. It is encouraging, however, that physical anthropology has been made, next to zoology and botany, the third required study [*Prüfungsfach*] for students of biology and of medicine.”

After recounting the complete destruction through fire of his institute in Breslau and the loss of all his personal possessions, except some books on India, Dr. von Eickstedt mentions that he was well treated by the Poles who “knew of his political position and scientific interest, his partly American origin and the Brazilian citizenship of his wife.” Of his new position in Mainz Dr. von Eickstedt says that he will have to build “from the ground up and this with grossly inadequate means and also that in Mainz they receive hardly half the food rations which are obtainable in Berlin.” In conclusion the hope is expressed again that some “exchanges” can be arranged and the following list of special desiderata is appended:

Taft, Human Migration
Garth, Race Psychology
Klineberg, Race Differences
Sorokin, Social Mobility
Dixon, Racial History
Kuczynski, Measurement of Population Growth
Shapiro, Heritage of the Bounty
MacCurdy, Early Man
Yerkes, Great Apes
Ross, Sociology
Thompson, Danger Spots in World Population
Huntington, Character of Races
Latourelle, The Chinese
Li Chi, Formation of Chinese People
Sorokin and Zimmerman, Principles of Rural and Urban Sociology
Herskowits, The American Negro

(Those wishing to send publications abroad may make use of “International Exchange Service,” Smithsonian Institution. There is no charge for this service.)

THE DISTRIBUTION OF BLOOD GROUPS IN RYUKYUANS [1]

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While Okinawa was still headline news, the writer had the opportunity to blood-group 1,549 natives located in the Military Government camps of Jinuza, Fukuyama and Soke. These people came from all parts of the island and probably represent a random sample of a population numbering over 435,000 before the war. All school children between 6 and 10 years old were tested in each camp. On 1 day a road block was set up in each camp so that every fourth adult passing through was also tested. The sample constitutes about 5% of the total population of the 3 camps.

Due to lack of other sera, study of this sample was limited to the A and B factors. Locally prepared high titre serum was used, and readings were made by the macroscopic slide method after 5 and 10 minutes by 2 observers. All differences between their findings were rechecked by macro- and microscopic means. The sera were obtained from naval corpsmen volunteers, and only those sera which gave macroscopic agglutination with appropriate cells on dilution of 1:10 were used. The titres were checked.

The blood group distributions and their gene frequencies for these Okinawans are given in table 1, along with previously published data on other Ryukyuans. The Kagoshima prefecture series includes the North Ryukyus (Amami, Tokara and Osumi Guntos) and Satsuma and Osumi provinces,

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[1] Data collected while the author was a medical officer in the U. S. Navy. The Bureau of Medicine and Surgery of the United States Navy does not undertake to endorse the findings or opinions expressed in this paper.

TABLE 1

Distribution of blood groups in the Ryukyu people.

GROUP [1]	INVESTIGATOR	NUMBER	PERCENTAGE OF GROUP				GENE FREQUENCY			D/σ
			O	A	B	AB	p	q	r	
Kagoshima Prefecture	Furuhata [2]	9,808	30.3	40.6	20.0	9.2	.292	.160	.531	1.5
Okinawa Prefecture	Furuhata	3,787	35.0	34.7	21.0	9.3	.243	.157	.593	0.3
Okinawa Prefecture	Haebara	12,385	32.2	35.8	21.8	10.1	.268	.143	.651	1.4
Okinawa Jima	Haebara	7,971	32.9	37.3	19.6	10.2	.271	.157	.573	1.6
Okinawa Jima	This study [3]	1,549	31.0	40.8	20.2	8.0	.291	.159	.557	1.4
Okinawa Jima	Kanazeki	387	32.0	36.7	20.1	11.1	.278	.170	.566	1.4
Okinawa Jima	Kirihara and Haku [2]	262	63.9	17.3	13.6	4.9	.102	.081	.799	4.2
Okinawa Jima (Itoman)	Kirihara and Haku	134	28.6	35.7	21.9	13.8	.266	.175	.535	1.4
Miyako Jima	Kanazeki	350	31.1	29.7	29.7	9.4	.220	.220	.588	0.2
Miyako Jima	Kirihara and Haku [2]	150	42.7	26.0	24.0	7.3	.176	.164	.653	0.6
Yonakuni Jima	Haebara	868	34.3	29.3	33.0	3.5	.196	.219	.586	0.9
Japanese — totals	All authors (Wiener)	301,959	30.5	38.2	21.9	9.4	.276	.171	.552	

[1] Locations of the series are given in Newman and Eng ('47, fig. 1).

[2] From Boyd ('39, p. 175, 178).

[3] Calculated from formulae $r = \sqrt{\bar{O}}$, $p = \sqrt{\bar{O} + \bar{A}} - \sqrt{\bar{O}}$, $q = \sqrt{\bar{O} + \bar{B}} - \sqrt{\bar{O}}$ (Schiff and Boyd, '42, p. 224).

South Kyushu. The Okinawa prefecture series covers the Central and South Ryukyus.

The history and physical anthropology of the Ryukyu people are summarized in Newman and Eng ('47) and need not be repeated here. Suffice it to say that racially the Ryukyuans have greater proportions of Ainu and Southern Mongoloid elements than do the Japanese, and that within historic times no ethnic minority of any importance has existed among them. Immigration has been scanty; intermixture with foreigners rare, particularly in the rural areas. Ryukyuans more closely resemble the South Kyushu people than other Japanese, and it would take an experienced observer to distinguish many of them.

As a whole, Ryukyuans differ slightly from Japanese in having somewhat less group A. Considered geographically, this slight difference becomes more apparent. Komatsu and Ito (Schiff and Boyd, '42, fig. 37) have shown that the gene frequency of group A decreases in regular fashion north and south of 2 narrowly separated areas of high frequency (>30) in Southwest Honshu and North Kyushu. To the south, South Kyushu shows a frequency of 28–29, and Haebara's series for Kagoshima province has a similar frequency of 29.2. Proceeding south along the Ryukyu chain, frequencies for Okinawa prefecture are reduced and range from 24.3 (Furuhata) to 26.8 (Haebara). This study gives the high frequency of 29.1 for Okinawa Jima, and Haebara's series for that island runs 27.1. Itoman, a fishing town in southwest Okinawa Jima, has a frequency of 26.6.

In the South Ryukyus, further reduction in A frequency is found. On Miyako Jima, the frequencies are 22.0 and 17.6. Farther west, Yonakuni Jima — only 100 miles from Formosa — has a frequency of 19.6. Thus there appears to be a fairly regular, progressive reduction of A frequency from north Kyushu to the south Ryukyus. In Formosa, half of the 28 native groups tested have A frequencies under 20, but a number of high frequencies are present as well. The Schiff and Boyd ('42, p. 204) isogenic map for group A shows a

25 isogene separating the south Ryukyus from Formosa. If the south Ryukyu data are reliable, this isogene might be moved east to, but not including, the central Ryukyus.

There is apparently no such even progression in the gene frequency of group B. In Japan proper, the frequencies range from 15.3–19.0 (Boyd, '39, pp. 176–180). Kagoshima prefecture has a frequency of 16.0; Okinawa prefecture ranges from 14.3–15.7, depending on the series. On Okinawa Jima, frequencies for this study and Haebara series are, respectively, 15.9 and 15.7. Itoman town runs 17.5. In the South Ryukyus, Miyako Jima has a 16.4 frequency, but Yonakuni Jima has a high of 21.9. On Formosa, only 4 of the 28 native groups have B frequencies over 20. The unusually high B frequency for Yonakuni Jima is explained by Haebara ('36, p. 119) as the result of inbreeding, and on the supposition that Yonakuni Jima people are different from the general run of Ryukyuans. Both A and B frequencies suggest that the South Ryukyuans in the Sakishima Gunto are serologically different from the other inhabitants of the Ryukyu chain, and that Ryukyuans as a group differ somewhat from Japanese.

SUMMARY

Shortly after the invasion, 1,549 natives of Okinawa Jima were tested for A and B blood factors. These people probably represent a random sample from all parts of the island. Racially, they differ slightly from Japanese due to greater proportions of Ainu and Southern Mongoloid elements. Within historic times little admixture with foreigners has occurred in the Central and South Ryukyus, especially in rural areas.

The results of this study, along with previously published data, indicate that, in general, Ryukyuans have a somewhat lower frequency of blood group A than Japanese. Extending the gene frequency map of Japan, it is apparent that from North Kyushu to the South Ryukyus there is a fairly regular decrease in group A. The South Ryukyuans are also characterized by a notably higher frequency of group B and appear quite different serologically from their neighbors to the north and most of the Formosans to the west.

ACKNOWLEDGMENT

The writer is indebted to Marshall T. Newman, Associate Curator, Division of Physical Anthropology of the Smithsonian Institution, for his invaluable cooperation in the preparation of this paper.

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Relative Biological Achievements.— There appears to be nothing abberant about the rise of man, no need to search for some *tertium quid* by which a whimsical Nature struck off at a new tangent to produce a cerebration which caricatures that of the mammalian rank and file. That *tertium quid* does not exist. In fact, if one is looking for a really great upsurging of cephalization, one should contemplate the long and steep rise (of the logarithms) from Reptilia to Insectivora, or the lesser, yet still enormous, achievement from Insectivora to Hapalidae. Compared with these, the rise from monkey to man is the smaller biological achievement. Let us not confuse standards. The *practical results* that come from the exercise of the aggregate human brain, the combined efforts of humans which we term ''culture,'' certainly are spectacular when compared with the analogous achievements of other animals. However, in the world of biological operations, especially when scaled in its intima by logarithms, the abysmal discrepancy does not exist.— Earl W. Count. Brain and body weight in man: Their antecedents in growth and evolution: A study in dynamic somatometry. Ann. N. Y. Acad. Sci., vol. 46, art. 10, 1947, pp. 993–1122.

DERMATOGLYPHICS IN MONGOLISM.— Twenty-one physicians have submitted [palm] prints from 86 infants and children, usually in groups including one or more normal subjects. Prints were marked for identification, with numbers or initials, but the interpreter had no information regarding the clinical status of the subjects. Reports to referring physicians rated the prints as negative, questionable, or typical of mongolism. . . .

Clinical data and diagnoses were subsequently obtained and compared with our dermatoglyphic interpretations. There was agreement of palmar and clinical diagnoses in 76 of 86 prints submitted. Forty-nine clinically certain mongoloids were correctly diagnosed from the prints, as were 27 normal controls. In the remaining 10, . . . unequivocal disagreement occurred 4 times, partial disagreement 3 times. Uncertainties of clinical diagnosis in 3 preclude their use in the measure of reliability, thus reducing the number available for such comparison to 83. . . .

The fact that readings were correct in 76 of 83 cases indicates an accuracy of about 92% for this mixed group. Palmar dermatoglyphics thus have substantial value for objective recognition of mongolism.— Harold Cummins and R. V. Platou. Mongolism: An objective early sign. South. Med. J., vol. 39, no. 12, 1946, pp. 925–928.

PHYSICAL DIFFERENCES AMONG THE MAYA.— In attempting to draw a picture of what the ancient Maya looked like, to describe their appearance and physical characteristics, we have four lines of evidence upon which to draw: (1) the modern descendants of the ancient Maya, especially in the northern half of the Yucatan Peninsula; (2) representations of the ancient Maya, sculptured on their monuments and painted in their codices, or hieroglyphic manuscripts, and in their frescoes, or on their pottery; (3) a few contemporary descriptions by Spanish writers of the sixteenth century; and (4) a relatively small amount of skeletal material recovered during the course of excavations throughout both the Old and New Empire regions. Of these four sources by far the most important is the first, the modern Maya of Yucatan, many of whom so closely resemble the figures on the monuments and in the paintings that they could have served as models for them.

. . . judging from general appearance, the highland Maya have a redder and more shiny skin than the Yucatan Maya, and biologically they seem to be of somewhat purer strain; that is they show less non-Maya admixture. However, judged by such basic criteria as stature, color, head-shape, and hair, all Maya-speaking groups would seem to have sprung originally from the same common ancestral stock.— Sylvanus G. Morley. *The Ancient Maya.* Stanford Univ. Press, Stanford University, California, xxxii + 520 pp., 1946.

THE BONY PELVIS IN PREPUBERAL CHILDHOOD

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FOURTEEN FIGURES

The present paper is concerned with certain aspects of growth in the bony pelvis during early childhood. It is the second study in a projected series, an earlier report (Reynolds, '45) having dealt with a similar investigation during the first postnatal year. Further studies are planned at the adolescent level and at maturity.

As in the previous infant study, measurements made on serial roentgenograms of the pelvis provide materials for analysis. In addition, however, the present paper will also discuss and illustrate individual patterns and differences in the development of the pelvis. The subjects, 183 children between the ages of 2 and 9 years, are regular participants in the longitudinal growth program of the Fels Research Institute.

The literature on the prepuberal growth of the pelvis is not extensive, and roentgenologic studies of this period are scarce. A discussion of relevant reports was given in the infant study, and Obiditsch ('39), in a paper on older children, surveys the earlier literature. The work of Ariens Kappers ('38) and Serra ('39) deserves mention, and the roentgenographic studies of Morton and Hayden ('41) and Morton ('42) should again be cited, as well as the recent paper by Greulich and Thoms ('44) on the growth of the superior pelvic aperture in girls during puberty.

Morton's paper, given at the 1942 meeting of the American Gynecological Society, is particularly significant, not only for its direct contributions, but also for the statements which were made in the ensuing discussion. Morton, commenting on changes in the shape of the bony pelvis, and the appearance of sexual differences, asks:

> "Are the variations in shape which are present in adult women observable in young girls? Are such variations observable in the fetal period? In short, are individuals endowed with factors which make for a given pelvic shape, which they thereafter retain unless influenced by specific diseases, such as rickets, or do all individuals start out life with pelves which are essentially similar which only later become modified in form? If the latter supposition is true, what are the changes, when do they occur, and what brings them about? When do the sexual differences appear and what brings them about?" (p. 799.)

Morton could find no significant sexual differences in fetal life, and only 2 possible differences in the years before puberty. "While it is impossible to deny categorically that differences do exist between the male and female before puberty, certainly the major differences appear at this time." (p. 815.)

In the discussion which followed, Dr. W. E. Caldwell said:

> "I wish Dr. Morton had not been so positive in his conclusions that sex variations before puberty are negligible. I do not think that contemporary anthropologists will agree with him in this statement. Dr. Wesley Dupertuis, after reading Dr. Morton's paper, made the following note: 'As an anthropologist having worked in the laboratory of Dr. Hooton, and perhaps having been influenced by his ideas, I have always felt that it was possible to determine the sex in the pelves of children, infants, and perhaps those of fetuses. Certainly from the osteologic material that I have seen, there seem to be tremendous differences in the pelves of small children. From Todd's own material and from the impression that I have gained from Hooton's and Hrdlicka's work, I believe that most anthropologists feel that pelvic sex differences are evident in early childhood and perhaps even in the intrauterine period.' . . . I hope Dr. Morton will con-

tinue his work and that more clinics will use x-ray techniques to study the development of the pelvis.'' (pp. 816-7.)

Dr. Paul Titus said:

''Another point that attracted me was the fascinating possibilities that lie in continuing these studies over a considerable period of years in the same individual, following each one from infancy to adult life.'' (p. 818.)

Dr. Howard C. Moloy made a reference to his own work in this area:

''Six years ago we [Caldwell and Moloy] obtained stereoroentgenograms on forty-three infants shortly after birth and from their study believed we recognized distinct sex differences . . . Dr. Morton also recognizes sex differences in infants and children but believes these differences are too slight to warrant consideration. This introduces a controversy which we believe should be settled . . .'' (p. 818.)

In closing the discussion, Dr. Morton said:

''I admit freely that the question of sex differences is still a matter of controversy . . . These facts may indicate that sex changes do start at a very young age. However, I do feel that the major changes appear at puberty and do not believe that the problem of whether there are any sex differences at all before this time can be settled until we have studied this question in more detail.'' (p. 819.)

These excerpts offer a cross-section of clinical opinion on problems of growth changes and sex differences in the bony pelvis, and have been quoted because of their special application to the present series of studies.

The infant pelvis study contained several sections which refer equally to the present report, and which will not be repeated here in detail. Among them are a discussion of the distinctive nature of the roentgenologic pelvis, an appraisal of the advantages and limitations of measurements taken upon a pelvic roentgenogram, and an interpretation of various roentgenometric values.

MATERIAL AND METHODS

The sample. The present series includes 92 boys and 91 girls, between the ages of 15 months and 9½ years, on whom 640 posture roentgenograms have been taken. The children are white, and all were born in southwest Ohio. Of the 95 cases reported on in the earlier infant study, 78 of them are also included in the present series.

TABLE 1

Distribution of cases by age-level.

SEX	AGE IN MONTHS										NUMBER OF ROENTGENOGRAMS
	15	22	34	45	57	69	78	90	102	114	
Boys	2	39	51	51	43	28	38	37	6	2	297
Girls	3	44	53	54	50	35	52	37	13	2	343
Total	5	83	104	105	93	63	90	74	19	4	640

TABLE 2

Distribution of cases by number of roentgenograms taken on each child.

SEX	NUMBER OF ROENTGENOGRAMS TAKEN							NUMBER OF CHILDREN
	7	6	5	4	3	2	1	
Boys	1	4	13	23	18	22	11	92
Girls	0	13	19	22	14	17	6	91
Total	1	17	32	45	32	39	17	183

The distribution of cases by age-levels at which the roentgenograms were taken is shown in table 1, while the distribution of cases by number of roentgenograms taken on each child is shown in table 2.

Over half the children have had 4 or more posture roentgenograms taken during the age-span considered. Normative data will be given only for the period between 22 and 90 months, inclusive.

The roentgenograms. Posture roentgenograms are taken on each Fels child at the age-levels indicated in table 1. These films are taken with the child standing in a prescribed anteroposterior position, feet pointed ahead and body touching the vertical cassette, with the rays centered to the knees at a 48-inch focal-film distance. Although the present study is concerned only with the pelvic area, such films visualize all of the lower extremities and most of the torso at these ages.

These posture films differ from pelvic roentgenograms of the supine child, which are also taken regularly, in 3 main ways: the child is standing; the focal-film distance is 48 inches instead of 36 inches; and the rays are centered in the midline to the knees rather than to the pubic symphysis. To test differences between pelvic measurements made on the 2 types of roentgenograms, a comparison was made of 50 cases taken at random from the series. It was possible to correct for the differences in the focal-film distance (Files, '44, p. 91) so that any differences between the 2 methods could be ascribed to the other 2 factors. The results are shown in table 3.

TABLE 3

A comparison of pelvic measurements from supine and standing children, based on values taken from 50 unselected cases.

ITEM	COEFFICIENT OF CORRELATION (r)	CRITICAL RATIO OF DIFFERENCE BETWEEN MEANS
Pelvis breadth	.97 ± .008	1.4
Pelvis height	.97 ± .008	.4
Bi-trochanteric breadth	.98 ± .006	.04
Inlet breadth	.97 ± .008	.7
Inlet, sagittal diameter	.80 ± .050	10.2

The measurements selected for comparison in table 3 consist of 2 external transverse values, pelvis breadth and bitrochanteric breadth; an internal transverse value, inlet breadth; pelvis height; and a value representing an anteroposterior dimension, the sagittal diameter of the inlet. As shown by the coefficient of correlation, the close association between the measurements is very evident. When mean values are compared, a statistically significant difference is shown only in the case of the sagittal inlet.

As discussed in the infant study, the sagittal inlet depth, unlike the transverse and most of the height measurements, does not represent the actual size of this dimension (taking ordinary radiographic distortion into consideration), without an additional correction for the tilt of the pelvis within the body. To obtain the true dimensions of the inlet, a special type of roentgenogram, such as has been described by Thoms ('33) and Thoms and Wilson ('38), must be employed. These are regularly taken on all Fels subjects at the adolescent period. The value of such a measurement as the sagittal inlet in the present study, therefore, lies in its correlational associations and in the demonstration of growth trends, rather than in any consideration of actual dimensions. The distinction between roentgenometric values which are essentially the same as osteometric values, and values which are roentgenologic "abstractions," will be made in the description of the measurements which follows:

The measurements. Tracings were made on all films. These tracings define the ilium, ischium and pubis on each side, as well as the upper portion of the femur, including the proximal epiphysis. All tracings showing gross positioning defects were discarded. Measurements were taken to the nearest half-millimeter, and all tracings, measurements and calculations were checked.

In the table below, the measurements, angles and indices taken are described, together with a note as to their relation to the values used in the infant study. Those items marked A are essentially similar to the same measurements if made directly on the pelvis. Those items marked B are roentgenologic in nature, rather than anatomic.

Eleven items are directly comparable to measurements taken in the infant study.

Pelvis height — The maximum distance between the upper edge of the iliac crest and the lower margin of the ischium. Right, left and average. (A)

Pelvis breadth — The maximum transverse distance between the outer borders of the iliac crests; corresponds to the anthropometric bi-iliac (r = 0.97, for 50 unselected cases). (A)

Inlet breadth — The maximum transverse diameter of the inlet. (A)

Inter-iliac breadth — The transverse distance between the posterior inferior iliac spines; corresponds closely to infant inter-iliac breadth, but definition differs slightly. (A)

Inter-pubic breadth — The minimum distance between the pubic bones. Traverses the area of the pubic symphysis. (A)

Inter-tuberal breadth — The transverse distance between the points defining the lower margins of the ischia. Corresponds closely to infant bi-ischial breadth, but no longer necessarily a *minimum* distance between the ischia. (A)

Ilium length — That portion of line defining pelvis height, which includes the ilium. (A-B) Right, left, average.

Pubic length — The distance from a point common to the ilium and ischium length lines, to a point where a line directed to the center of the pubic symphysis is cut off by the pubis. This item is now the measurement of an area, rather than of an individual bone. Right, left, average. (A-B)

Inlet, sagittal diameter — The antero-posterior distance from the center of a line defining the posterior surface of the pubic symphysis to the line defining the inter-iliac breadth. (B)

Ischium length — That portion of line defining pelvis height, which includes the ischium. This item is now the measurement of an area, rather than of an individual bone. Right, left, average. (B)

Breadth of iliac notch — The breadth of the sacro-iliac notch, insofar as it is, at these age-levels, contained entirely within the ilium. Called ''breadth of greater sciatic notch'' in infant study. Right, left, average (B)

Three new lengths and 4 new angles were taken:

Inter-obturator breadth — The minimum transverse distance between the inner borders of the obturator foramina. (A)

Bi-trochanteric breadth — Maximum distance between the great trochanters. (A)

Length of femoral neck — The distance, as measured in the mid-line of the femoral neck, from the upper edge of the proximal epiphysis to the outer margin of the shaft of the femur. Right, left, average. (A)

Pubic angle — The angle made by tangents to the inferior ramus of each pubis, converging at the point defining the center of the pubic symphysis.

Pelvic angle — The angle made by the convergence of lines defining the right and left pelvis heights.

Femoral angle — The angle made by the line defining the length of the femoral neck, at its junction with a line defining the mid-line of the shaft of the femur. Right, left, average.

Femoral-pelvic angle — The angle made by an extension of the line defining the length of the femoral neck, at its junction with the line defining pelvis height. Right, left, average.

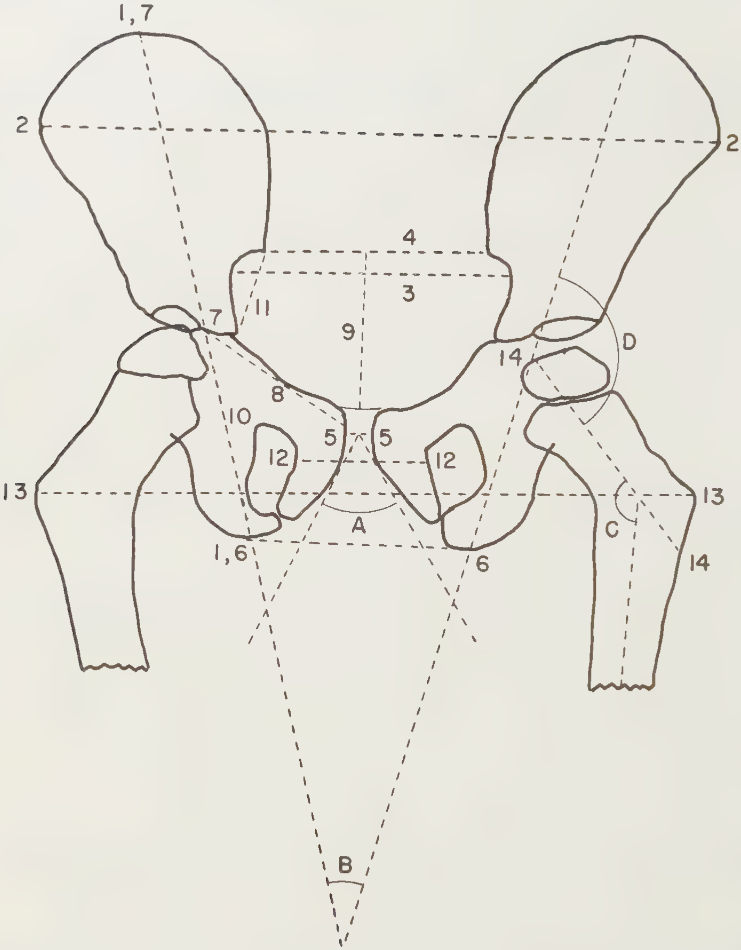

Fig. 1 The measurements as taken from a pelvic tracing: 1, pelvis height; 2, pelvis breadth; 3, inlet breadth; 4, inter-iliac breadth; 5, inter-pubic breadth; 6, inter-tuberal breadth; 7, ilium length; 8, pubis length; 9, inlet, sagittal diameter; 10, ischium length; 11, breadth of iliac notch; 12, inter-obturator breadth; 13, bi-trochanteric breadth; 14, length of femoral neck; A, pubic angle; B, pelvic angle; C, femoral angle; D, femoral-pelvic angle.

The 4 indices calculated were also used in the infant study:

Pelvic index — $\frac{\text{Pelvis height}}{\text{Pelvis breadth}} \times 100.$

Inlet index — $\frac{\text{Inlet, sagittal diameter}}{\text{Inlet breadth}} \times 100.$

Relative sacrum breadth — $\frac{\text{Inter-iliac breadth}}{\text{Pelvis breadth}} \times 100.$ This item was called the "sacral index" in the infant study.

Relative inlet breadth — $\frac{\text{Inlet breadth}}{\text{Pelvis breadth}} \times 100.$

The 14 direct measurements and the 4 angles are illustrated in figure 1.

In the present study, both right and left sides were measured on all paired items, and the average value used. Tests of significance of differences between mean values for right and left sides showed no consistent trends, with 1 exception: in boys, the left femoral angle and the left femoral-pelvic angle were significantly larger at several age-levels. These were the only evidences in either sex of any overall tendency toward pelvic asymmetry. Coefficients of correlation between right and left sides of the pelvis are shown for a number of characteristics in table 4.

TABLE 4

Coefficients of correlation between measurements on right and left sides of pelvis.

ITEM	34 MONTHS (n = 70) r	78 MONTHS (n = 60) r
Pelvis height	.93	.93
Ilium length	.88	.84
Ischium length	.86	.91
Pubis length	.23	.28
Length of femoral neck	.79	.62
Femoral angle	.40	.51
Femoral-pelvic angle	.25	.32

Finally, as in the infant study, the following statement should be made: reference to any item, such as pelvic height, is merely a convenient way of saying "height of the shadow of the pelvis upon the roentgenogram, as measured according to the description given."

RESULTS

Topics to be considered include growth changes, sex differences, and individual patterns and differences in pelvic development. The first 2 items involve a consideration of the group, and are statistical and normative in nature; the last item involves a consideration of individual children, and is observational and descriptive in nature.

1. Growth changes in the pelvis from 22 through 90 months

Intercorrelations of measurements at 34 months. The 18 basic measurements and the 4 indices were intercorrelated (Pearson r) at 34 months. Boys and girls were treated separately, and the coefficients combined by the z-method of Fisher ('32, p. 183). Sex differences will be discussed in the next section. Between 90 and 100 paired items went into each coefficient. For 90 pairs, a coefficient of 0.27 is considered significant at the 1% level. In table 5, coefficients are indicated for 14 items.

The following 10 items form a significantly intercorrelated group: inter-iliac breadth, inter-obturator breadth, bi-trochanteric breadth, inter-tuberal breadth, ischium length, pubis length, length of femoral neck, pelvis breadth, inlet breadth and pelvis height. All items in this group show values of + 0.27 or over, except inter-iliac breadth and length of femoral neck (+0.21) and inter-obturator breadth and length of femoral neck (+0.25). These inter-related values represent all the transverse measurements except inter-pubic breadth, and in addition pelvis height, the ischium and pubis lengths, and femoral neck length. Ilium length, although significantly associated with several of the items, is not clearly within this syndrome.

A smaller group of significantly inter-related variables includes the sagittal diameter of the inlet, pelvis breadth, inlet breadth, pelvis height and ilium length. The breadth of the iliac notch, closely associated (+0.77) with sagittal inlet and ilium length, is not significantly related to the other 3 items.

Two other associations, in the 14 basic items, show significance: the positive coefficient between bi-trochanteric breadth and the sagittal inlet, and the negative association between inter-pubic breadth and iliac notch.

TABLE 5

Intercorrelation of 14 measurements at 34 months, sexes combined.[1]

		B	C	D	E	F	G	H	I	J	K	L	M	N
A	Inter-iliac breadth	46	54	41	41	43	21	54	70	55	27	+	—	+
B	Inter-obturator breadth		54	56	41	54	25	53	54	45	+	+	+	+
C	Bi-trochanteric breadth			52	56	58	66	60	59	80	56	37	+	—
D	Inter-tuberal breadth				59	73	31	38	45	46	+	—	—	+
E	Ischium length					82	52	57	48	77	+	—	—	+
F	Pubis length						53	54	53	66	+	+	—	—
G	Length of femoral neck							51	35	64	38	+	+	—
H	Pelvis breadth								73	68	51	33	+	+
I	Inlet breadth									42	49	30	+	+
J	Pelvis height										76	52	+	—
K	Ilium length											65	55	—
L	Inlet, sagittal diameter												77	—
M	Breadth of iliac notch													—35
N	Inter-pubic breadth													

[1] Arranged so as to group interrelated variables. Decimal points omitted. Solitary plus or minus indicates value below .27.

Table 5 does not include the coefficients in which angles are involved. A few significant values appear, the nature of such relationships in each case being easily apparent. Amongst the angles themselves, the femoral-pelvic angle is positively correlated (+0.78) with the femoral angle, and negatively correlated (—0.38) with the pelvic angle. When related to the basic measurements, the following significant associations are shown: pubic angle and inter-pubic breadth, +0.43; pelvic angle and inter-tuberal breadth, +0.35; femoral angle and inter-obturator breadth, —0.28, and with bi-trochanteric breadth, —0.40; femoral-pelvic angle and length of femoral neck, +0.30, and with sagittal inlet, —0.32.

In table 6, the 18 variables are ranked in the order of their inter-correlating effectiveness. Eleven of these items have a counterpart in the infant study, and a comparison of these rankings is also given.

Some shifts appear to have taken place, between infancy and childhood, in intercorrelating effectiveness; for instance, pelvis height, formerly ranked seventh, is now first, while the sagittal inlet, formerly second, is now ninth. Most items, however, have maintained their approximate positions at both periods: pelvis breadth, inlet breadth, ischium length, ilium length, inter-iliac breadth, iliac notch and inter-pubic breadth.

TABLE 6

Measurements and indices ranked by effectiveness of intercorrelation.

ITEM	RANK	RANK WHEN RELATED TO INFANT STUDY	RANK SHOWN IN INFANT STUDY
Bi-trochanteric breadth	1		
Pelvis height	2	1	7
Pelvis breadth	3	2	3
Inlet breadth	4	3	1
Pubis length	5	4	8
Inter-tuberal breadth	6	5	11
Ischium length	7	6	9
Inter-obturator breadth	8	..	..
Inter-iliac breadth	9	7	4
Length of femoral neck	10	..	.
Ilium length	11	8	5
Inlet, sagittal diameter	12	9	2
Breadth of iliac notch	13	10	6
Inter-pubic breadth	14	11	10
Femoral-pelvic angle	15		
Femoral angle	16	.	..
Pubic angle	17	.	.
Pelvic angle	18	..	..

In general, as in the infant study, a rather high correlation pattern is shown between measurements taken at 34 months.

Fifty-seven of the 91 coefficients between the 14 basic items show significance at the 1% level. The simple arithmetical average for the intercorrelation coefficients of the 11 variables also contained in the infant study is 0.363; in the infant study this value was 0.406. Two syndromes exist, one of 10 variables chiefly related to transverse measurements, and 1 of 5 variables which includes the sagittal inlet.

Growth norms and growth curves between 22 and 90 months. Tables 7, 8 and 9 present means, standard deviations, and coefficients of variation for the various items, by sex and by age.

The range in the size of the bony pelvis in childhood is illustrated in figure 2, in which the superimposed pelvic tracings for 2 boys, both aged 45 months, are shown. The pelvis of the larger boy is not only more rugged, but is more mature skeletally, aside from the factor of size, as is indicated by the shape of the proximal femoral epiphyses and by the completed obturator foramina.

The progressive deceleration in rate of growth seen during the first year of life continues through this period of childhood. This is most clearly shown in the growth curves for pelvis breadth and pelvis height, which are given in figure 3, together with the curves for inlet breadth and inter-iliac breadth.

Additional curves are shown in figure 4 for inter-tuberal breadth, pubis length, inter-obturator breadth and breadth of iliac notch. In figure 5, the trends for 2 angles are shown; the pubic angle shows clearly a decrease with time, while the pelvic angle remains about constant during this period.

The coefficient of variation tends to become slightly larger with time in most cases. The mean coefficient for 44 values at each age-level (22 items for each sex) rises from 9.04 at 22 months to 10.09 at 90 months. There are, however, many individual exceptions to this tendency. The behavior of coefficients for individual variables shows a pattern very similar to the infant study: usually low, but rising in such items as inter-pubic breadth and sagittal inlet.

TABLE 7

Means, standard deviations (S.D.) and coefficients of variation (C.V.) for 14 pelvic items, from 22 through 90 months.

AGE IN MONTHS	BOYS n	BOYS Mean	BOYS S.D.	BOYS C.V.	GIRLS n	GIRLS Mean	GIRLS S.D.	GIRLS C.V.
			Pelvis height (mm)					
22	39	110.0	4.4	4.0	43	106.5	5.0	4.7
34	49	121.9	4.7	3.8	51	119.2	5.7	4.8
45	50	130.9	6.7	5.1	53	129.5	6.2	4.8
57	43	140.4	8.1	5.8	50	138.4	7.5	5.4
69	25	148.9	8.0	5.4	35	147.9	7.7	5.2
78	37	156.9	8.9	5.6	47	153.0	9.2	6.0
90	32	164.5	7.6	4.6	32	159.5	7.9	5.0
			Pelvis breadth (mm)					
22	38	143.4	5.8	4.0	42	138.2	7.0	5.1
34	48	159.0	6.2	3.9	50	156.2	7.5	4.8
45	47	170.7	7.7	4.5	54	168.6	9.4	5.6
57	42	181.1	8.0	4.4	50	177.4	9.2	5.2
69	25	190.1	8.0	4.2	32	187.5	9.3	5.0
78	33	195.4	9.7	5.0	43	191.7	10.3	5.4
90	22	201.2	8.7	4.3	27	196.5	8.7	4.4
			Inlet breadth (mm)					
22	36	66.4	3.5	5.3	41	64.7	3.4	5.2
34	46	72.1	3.2	4.4	49	71.1	4.2	6.0
45	50	76.3	3.6	4.7	50	75.9	3.8	4.9
57	42	80.7	4.4	5.4	49	79.2	4.9	6.2
69	25	82.8	4.2	5.1	35	82.1	4.2	5.1
78	37	85.5	6.3	7.4	51	84.3	5.7	6.8
90	33	88.8	4.5	5.0	33	87.7	5.7	6.5
			Inter-iliac breadth (mm)					
22	35	52.5	3.4	6.4	41	50.8	2.9	5.7
34	46	56.2	2.6	4.6	49	55.2	3.1	5.6
45	50	58.8	2.8	4.7	50	57.4	3.1	5.4
57	43	62.2	3.4	5.5	49	59.8	4.3	7.1
69	24	63.4	3.3	5.1	35	62.0	3.9	6.2
78	36	65.6	4.0	6.0	51	64.5	5.7	8.8
90	33	68.1	4.7	6.9	33	66.6	5.0	7.5
			Inter-pubic breadth (mm)					
22	37	7.0	1.6	23.4	43	7.9	1.9	24.0
34	51	6.6	1.7	25.0	51	7.2	2.4	33.1
45	51	6.3	1.5	23.2	54	6.7	1.9	29.0
57	43	6.3	1.5	23.8	50	6.3	2.2	35.5
69	25	6.3	1.4	22.3	35	6.4	1.9	29.7
78	38	6.1	1.9	30.8	52	6.1	1.8	30.0
90	33	6.0	1.5	24.4	36	6.5	2.2	33.2

TABLE 7 (*continued*)

AGE IN MONTHS	BOYS				GIRLS			
	n	Mean	S.D.	C.V.	n	Mean	S.D.	C.V.
Inter-tuberal breadth (mm)								
22	40	47.4	3.6	7.5	43	50.6	4.4	8.6
34	52	52.4	4.6	8.7	52	56.3	5.4	9.6
45	51	56.7	4.4	7.7	56	61.7	4.7	7.6
57	43	60.7	4.9	8.1	50	66.2	5.2	7.8
69	27	65.7	6.4	9.7	35	70.3	5.0	7.1
78	39	67.7	6.3	9.3	52	72.2	5.5	7.6
90	37	69.9	6.7	9.5	36	76.1	6.8	9.0
Ilium length (mm)								
22	36	60.5	3.0	5.0	42	58.8	4.0	6.7
34	50	66.7	2.9	4.4	50	65.4	4.4	6.8
45	50	71.6	3.7	5.2	51	70.5	4.5	6.4
57	43	77.1	5.7	7.4	50	74.8	5.4	7.2
69	24	80.9	5.5	6.8	35	79.4	6.0	7.5
78	35	83.5	5.7	6.8	47	82.5	6.7	8.1
90	31	89.3	5.4	6.1	30	85.8	5.1	5.9
Pubis length (mm)								
22	36	39.2	3.0	7.6	42	39.3	2.9	7.3
34	50	44.9	3.8	8.5	51	45.2	3.5	7.7
45	51	48.4	4.2	8.8	51	50.6	3.1	6.1
57	43	52.5	4.4	8.4	50	54.4	3.9	7.2
69	24	56.0	4.7	8.4	35	58.7	3.8	6.5
78	35	60.1	4.3	7.2	49	60.6	4.5	7.4
90	31	61.7	4.8	7.8	30	63.3	4.7	7.4
Inlet, sagittal diameter (mm)								
22	35	27.7	4.5	16.2	42	26.3	4.8	18.4
34	46	29.8	4.4	14.8	50	30.0	4.7	15.7
45	50	31.5	5.8	18.4	51	32.9	6.0	18.4
57	42	34.6	7.2	20.8	49	34.5	5.8	16.7
69	25	33.4	7.0	20.8	35	36.5	7.6	20.9
78	37	36.0	8.8	24.3	52	37.5	8.6	22.9
90	33	41.0	8.1	19.8	32	39.0	8.0	20.5
Ischium length (mm)								
22	36	49.1	2.7	5.4	42	47.7	3.5	7.3
34	50	55.2	3.7	6.7	50	53.7	3.3	6.2
45	51	59.4	4.3	7.2	52	59.1	3.4	5.7
57	43	63.5	4.3	6.7	50	63.7	4.3	6.7
69	24	67.5	4.6	6.9	35	68.5	4.6	6.7
78	35	72.7	4.4	6.0	49	70.9	5.3	7.4
90	32	75.9	5.2	6.8	31	73.9	5.4	7.3

TABLE 7 (*continued*)

AGE IN MONTHS	BOYS n	Mean	S.D.	C.V.	GIRLS n	Mean	S.D.	C.V.
		Breadth of iliac notch (mm)						
22	36	12.7	3.9	30.5	41	12.1	3.4	27.8
34	46	13.7	2.8	20.5	51	14.4	3.7	25.5
45	50	13.9	3.3	23.8	50	15.5	3.6	23.2
57	43	15.5	4.0	25.6	49	16.6	4.2	25.2
69	25	15.0	3.6	24.3	34	16.7	4.7	28.1
78	37	15.0	4.6	30.9	50	17.3	5.3	30.5
90	32	17.1	4.2	24.8	31	18.6	4.9	26.3
		Inter-obturator breadth (mm)						
22	37	26.2	2.1	7.9	43	26.5	1.5	5.7
34	51	27.8	2.0	7.2	52	28.7	1.9	6.7
45	51	29.1	2.2	7.5	55	30.5	2.3	7.6
57	43	31.3	2.2	7.2	50	31.8	2.3	7.1
69	27	33.1	2.4	7.3	35	33.7	2.3	6.8
78	39	34.3	2.6	7.6	52	34.4	2.6	7.4
90	37	36.1	3.0	8.3	37	36.3	3.0	8.4
		Bi-trochanteric breadth (mm)						
22	39	148.6	6.6	4.5	43	143.0	7.0	4.9
34	50	161.1	7.2	4.4	52	157.8	8.5	5.4
45	48	171.2	8.9	5.2	55	169.5	8.1	4.8
57	40	181.4	9.1	5.0	49	178.8	9.1	5.1
69	26	191.7	10.3	5.4	29	187.8	9.4	5.0
78	35	197.0	9.1	4.6	40	192.1	9.0	4.7
90	24	202.8	10.0	4.9	23	199.4	8.8	4.4
		Length of femoral neck (mm)						
22	37	48.4	3.0	6.1	43	45.2	3.5	7.8
34	51	53.8	3.6	6.7	53	52.2	4.2	8.1
45	51	59.2	4.3	7.2	53	58.3	4.2	7.3
57	43	64.5	4.6	7.1	50	63.6	5.0	7.9
69	25	69.0	4.3	6.2	35	68.8	5.3	7.8
78	37	74.5	5.3	7.1	52	71.7	6.1	8.5
90	34	78.5	4.8	6.1	35	75.5	5.6	7.5

The relation of values at 34 months to values at 57 months. In the infant study, an examination was made of the relationship of certain measurements taken at birth to those same measurements at 12 months. In table 10 a similar comparison is made for the period between 34 months and 57 months, and the infant values where available are also shown.

TABLE 8

Means, standard deviations (S.D.) and coefficients of variation (C.V.) for 4 angles, from 22 through 90 months.

AGE IN MONTHS	BOYS				GIRLS			
	n	Mean	S.D.	C.V.	n	Mean	S.D.	C.V.
		Pubic angle (degrees)						
22	36	61.5	7.3	11.8	43	66.1	10.6	16.0
34	51	56.5	7.1	12.6	52	62.4	9.4	15.0
45	51	51.8	8.4	16.1	54	58.5	9.3	16.0
57	43	51.7	8.8	16.9	50	55.4	10.7	19.3
69	25	45.4	7.4	16.4	35	52.0	11.2	21.5
78	38	47.2	8.7	18.4	52	52.9	12.2	23.0
90	34	46.1	7.9	17.2	36	50.8	12.7	25.0
		Pelvic angle (degrees)						
22	37	32.9	3.8	11.7	43	30.0	3.5	11.6
34	48	33.4	3.6	10.9	49	31.8	3.2	9.9
45	49	33.5	3.1	9.2	51	32.3	3.5	10.9
57	43	33.6	3.3	9.9	50	31.3	4.8	15.3
69	25	33.4	3.9	11.6	35	31.6	4.5	14.2
78	34	33.7	4.1	12.3	46	31.4	4.7	15.0
90	28	33.2	4.3	13.0	29	30.7	4.7	15.2
		Femoral angle (degrees)						
22	39	142.3	4.7	3.3	43	142.2	3.0	2.1
34	51	139.1	4.5	3.2	53	138.8	4.2	3.0
45	51	137.7	5.0	3.6	55	139.0	4.5	3.2
57	43	138.1	4.6	3.4	50	138.6	4.8	3.4
69	27	135.6	4.9	3.6	35	136.7	5.1	3.7
78	39	138.2	4.9	3.5	52	137.0	5.0	3.6
90	37	138.1	4.4	3.2	36	137.4	4.9	3.6
		Femoral-pelvic angle (degrees)						
22	38	130.7	4.5	3.5	43	132.8	3.4	2.6
34	50	129.8	4.0	3.1	52	131.1	4.7	3.6
45	51	129.0	4.9	3.8	52	130.7	4.6	3.5
57	43	129.7	4.7	3.6	50	131.3	5.3	4.0
69	25	127.7	5.3	4.1	35	130.1	6.1	4.7
78	37	129.7	5.7	4.4	49	130.4	5.0	3.9
90	33	130.6	4.5	3.4	33	130.6	5.4	4.1

The coefficients of correlation for the latter age-period are larger for each item considered. All the values are significant at the 1% level. The increases in the coefficients for ilium length, pubis length and breadth of iliac notch are particularly marked.

TABLE 9

Means, standard deviations (S.D.) and coefficients of variation (C.V.) for 4 indices, from 22 through 90 months.

AGE IN MONTHS	BOYS				GIRLS			
	n	Mean	S.D.	C.V.	n	Mean	S.D.	C.V.
Pelvic index (per cent)								
22	37	76.6	2.8	3.6	42	77.0	2.9	3.8
34	47	76.4	2.3	3.0	49	76.2	2.8	3.7
45	47	76.4	2.8	3.7	52	77.0	2.9	3.8
57	42	77.3	3.1	4.0	50	78.1	3.0	3.8
69	24	78.3	3.3	4.2	32	78.9	3.6	4.6
78	33	80.1	3.6	4.5	43	79.3	3.6	4.5
90	22	81.6	3.3	4.0	26	80.7	3.0	3.7
Inlet index (per cent)								
22	35	42.0	7.0	16.6	41	40.6	7.2	17.6
34	46	41.4	6.2	15.0	49	42.4	6.6	15.6
45	50	41.3	7.2	17.5	50	43.1	7.9	18.4
57	42	42.7	8.0	18.8	49	43.5	7.2	16.6
69	25	40.5	8.7	21.5	35	44.5	9.6	21.5
78	37	42.0	9.2	22.0	51	45.5	10.2	22.4
90	33	46.2	9.1	19.7	32	44.6	9.2	20.6
Relative sacrum breadth (per cent)								
22	33	36.6	1.7	4.6	41	36.5	2.8	7.6
34	44	35.4	1.6	4.5	48	35.4	1.8	5.1
45	47	34.5	1.8	5.3	50	34.0	1.8	5.3
57	42	34.4	1.8	5.1	49	33.7	1.8	5.3
69	23	33.4	1.4	4.1	32	33.2	1.7	5.0
78	31	33.6	1.5	4.4	42	33.2	1.8	5.4
90	20	33.0	1.4	4.2	26	33.8	2.0	6.1
Relative inlet breadth (per cent)								
22	34	46.2	1.7	3.7	41	46.9	2.2	4.7
34	44	45.4	1.5	3.4	48	45.6	1.8	3.9
45	47	44.8	1.7	3.8	50	45.0	1.9	4.2
57	42	44.3	1.9	4.3	49	44.6	1.9	4.3
69	23	43.4	1.4	3.3	32	43.7	1.9	4.4
78	31	43.8	2.5	5.7	42	43.6	2.4	5.6
90	20	43.8	1.6	3.5	26	44.4	2.1	4.8

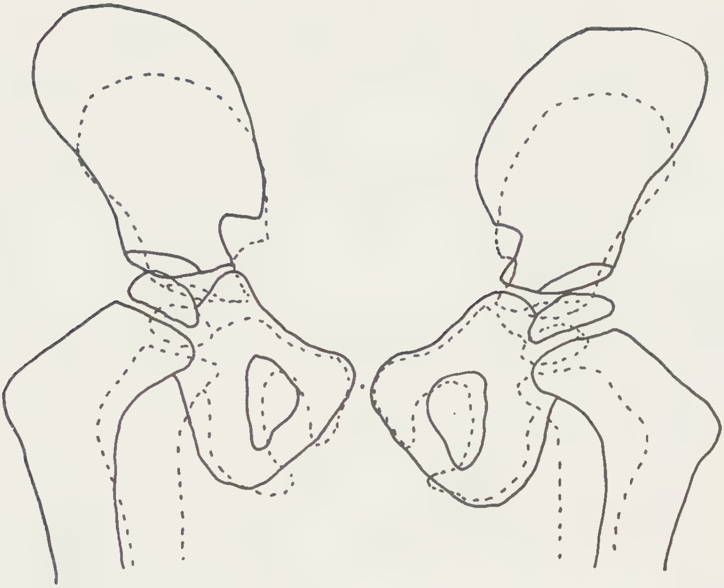

Fig. 2 Contrast in size of pelvis in 2 boys at 45 months.

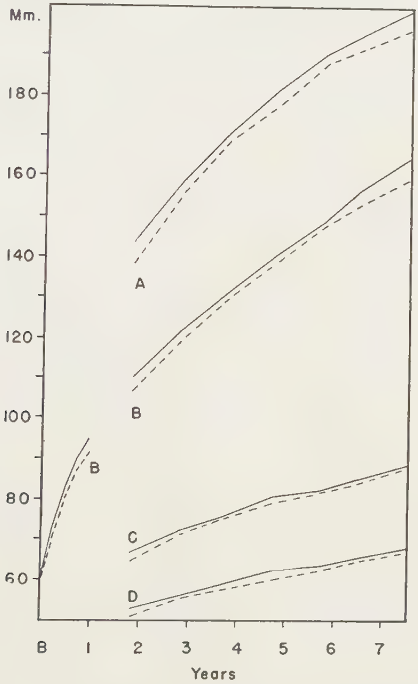

Fig. 3 Growth curves: A, pelvis breadth; B, pelvis height; C, inlet breadth; D, inter-iliac breadth. Boys, solid lines; girls, broken lines. Note that the boys' means are larger. The curve for the first year is from the infant study.

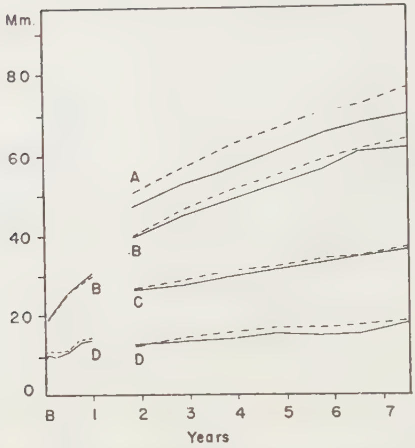

Fig. 4 Growth curves: A, inter-tuberal breadth; B, pubis length; C, inter-obturator breadth; D, breadth of iliac notch. Boys, solid lines; girls, broken lines. Note that the girls' means are larger. The curves for the first year are from the infant study.

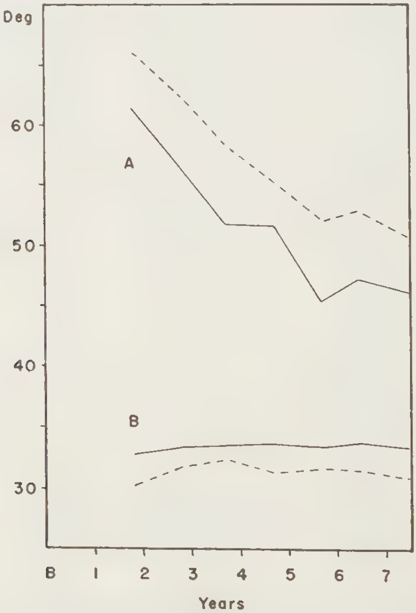

Fig. 5 Growth curves: A, pubic angle; B, pelvic angle. Boys, solid lines; girls, broken lines.

TABLE 10

Coefficient of correlation (r) between size of a part at 34 months and size at 57 months.

ITEM	N	r	INFANT STUDY (Between birth and 1 year, n = 60.)
Pelvis height	53	+ .89	+ .62
Ilium length	54	+ .78	+ .38
Ischium length	54	+ .81	+ .75
Pubis length	54	+ .82	+ .40
Breadth of iliac notch	53	+ .56	+ .02
Pelvis breadth	53	+ .89	.....
Inlet, sagittal diameter	49	+ .53	.....
Pubic angle	57	+ .42	.....

2. *Sex differences*

Sex differences in pattern of intercorrelation. In table 11, the intercorrelation coefficients discussed in general in the previous section are now examined with particular reference to sex differences.

Using 0.37 as a point of significance at the 1% level, table 11 indicates which items are significantly correlated for both sexes, and which for 1 sex only. In 43 pairs of items, both sexes show significant correlations; the boys show a significant association in another 4 pairs, and the girls in 16 pairs. The tendency for the higher frequency of significant coefficients among the girls is clear, and is borne out by the simple arithmetic means of the 91 coefficients obtained for each sex. The mean r for boys is 0.365, for girls, 0.409.

This finding is in contrast to a similar comparison of the sexes during infancy. Here the tendency for higher correlations was shown by the boys, who had a mean r of 0.407, while the average for the girls was 0.355.

Sex differences in measurements, angles and indices. The norms shown in tables 7, 8 and 9 have been tested for the significance of differences between mean values for boys and girls, at each age-level. The results, in terms of the critical ratio, are shown in table 12.

A critical ratio of 2.0 or more indicates a difference that is significant at the 5% level or lower. The items which show such significant differences are listed in table 13, and a comparison is made at the same time with the results from the infant study.

Significant sex differences are found at 1 or more age-levels for all characteristics except the sagittal inlet, femoral angle, pelvic index, relative sacrum breadth, and relative inlet breadth. The similarity of the findings of the present study to the infant study is evident. Again the boys tend to lead in such items as pelvis height and breadth, ilium length, and inter-iliac breadth, as well as in 3 new variables: bi-trochanteric breadth, length of femoral neck, and pelvic angle. They are also larger in inlet breadth (22 months only) and in

TABLE 11

Sex differences in intercorrelations of measurements and angles.

ITEM	NUMBER OF SIGNIFICANT (1% LEVEL) CORRELATIONS			
	Both sexes	Boys only	Girls only	Total
Pelvis height	11	0	0	11
Pelvis breadth	9	0	1	10
Inlet breadth	7	0	4	11
Inter-iliac breadth	4	0	4	8
Inter-pubic breadth	1	1	0	2
Inter-tuberal breadth	7	0	3	10
Ilium length	4	0	3	7
Pubis length	8	0	1	9
Inlet, sagittal diameter	3	1	4	8
Ischium length	7	0	2	9
Breadth of iliac notch	2	1	0	3
Inter-obturator breadth	5	1	3	9
Bi-trochanteric breadth	10	2	0	12
Length of femoral neck	5	0	3	8
Pubic angle	1	0	1	2
Pelvic angle	0	0	1	1
Femoral angle	1	2	0	3
Femoral-pelvic angle	1	0	2	3
Totals	86	8	32	126

TABLE 12

Critical ratios of differences between means of boys' and girls' measurements, angles and indices.[1]

ITEM	AGE-LEVEL, MONTHS						
	22	34	45	57	69	78	90
Pelvis height (B)	3.3	2.6	1.1	1.2	.5	2.0	2.6
Pelvis breadth (B)	3.7	2.2	1.3	2.1	1.1	1.6	1.9
Inlet breadth (B)	2.1	1.3	.6	1.6	.6	.9	.9
Inter-iliac bredth (B)	2.4	1.8	2.3	2.9	1.5	1.1	1.2
Inter-pubic breadth (G)	2.4	1.4	1.2	.1	.4	.1	1.0
Inter-tuberal breadth (G)	3.7	4.4	5.8	5.4	3.0	3.5	4.0
Ilium length (B)	2.1	1.8	1.4	2.0	1.0	.7	2.7
Pubis length (G)	.2	.5	3.1	2.3	2.4	.6	1.3
Inlet, sagittal diameter	1.4B	.2G	1.2G	.1B	1.6G	.8G	1.0B
Ischium length	2.0B	2.1B	.3B	.2G	.8G	1.7B	1.5B
Breadth of iliac notch (G)	.8B	1.0	2.2	1.3	1.6	2.2	1.3
Inter-obturator breadth (G)	.8	2.2	3.2	1.1	1.0	.2	.3
Bi-trochanteric breadth (B)	3.7	2.2	1.1	1.4	1.5	2.4	1.3
Length of femoral neck (B)	4.4	2.1	1.1	.9	.1	2.3	2.4
Pubic angle (G)	2.3	3.6	3.9	1.8	2.8	2.6	1.9
Pelvic angle (B)	3.4	2.4	1.9	2.8	1.7	2.3	2.1
Femoral angle	.1B	.3B	1.4G	.6G	.9G	1.1B	.6B
Femoral-pelvic angle (G)	2.4	1.6	1.8	1.5	1.6	.6	.1
Pelvic index	.7G	.4B	1.0G	1.3G	.6G	1.0B	1.1B
Inlet index (G)	.9B	.8	1.2	.5	2.0	1.7	.7B
Relative sacrum breadth (B)	1.7	.0	1.5	1.8	.5	1.1	1.6G
Relative inlet breadth (G)	1.5	.7	.7	.9	.7	.4B	.9

[1] B indicates boys' mean larger; G indicates girls' mean larger.

TABLE 13

Significant (5% level) sex differences in means.

ITEM	SEX LEADING	AGE-LEVELS	INFANT STUDY
Pelvis height	Boys	22, 34, 78, 90	Same
Pelvis breadth	Boys	22, 34, 57	Same
Inlet breadth	Boys	22	Not significant
Inter-iliac breadth	Boys	22, 45, 57	Same direction
Inter-pubic breadth	Girls	22	Not significant
Inter-tuberal breadth	Girls	All ages	Same
Ilium length	Boys	22, 57, 90	Same direction
Pubis length	Girls	45, 57, 69	Same
Ischium length	Boys	22, 34	Not significant
Breadth of iliac notch	Girls	45, 78	Same
Inter-obturator breadth	Girls	34, 45	No data
Bi-trochanteric breadth	Boys	22, 34, 78	No data
Length of femoral neck	Boys	22, 34, 78, 90	No data
Pubic angle	Girls	22, 34, 45, 69, 78	No data
Pelvic angle	Boys	22, 34, 57, 78, 90	No data
Femoral-pelvic angle	Girls	22	No data
Inlet index	Girls	69	Same direction

ischium length. Again, as in the infant study, the girls tend to lead in such items as inlet index (69 months), inter-pubic breadth, inter-tuberal breadth, pubis length, and breadth of iliac notch, and also in 3 new variables: inter-obturator breadth, pubic angle, and femoral-pelvic angle (22 months).

These results appear to strengthen the suggestion made in the previous infant study, that boys tend to be larger in measurements which represent the outer structure of the pelvis, while girls tend to be larger in measurements which represent the inner structure.

It was also noted in the infant study that the values of the critical ratio seemed to show a slight tendency to become smaller with age, within a particular measurement. There is a certain amount of evidence in the present study that this indeed seems to be the case, during the age-period here considered. Certainly the sex differences are more pronounced at 22 months than at any of the 6 succeeding age-levels. The mean critical ratio at 22 months is 2.1; at succeeding age-levels it is as follows: 34 months, 1.6; 45 months, 1.8; 57 months, 1.5; 69 months, 1.3; 78 months, 1.4; 90 months, 1.5. There are of course many individual exceptions, but the trend is evident. At 22 months there are 13 significant sex differences; at the 6 subsequent age-levels the number is 9, 5, 6, 4, 7 and 5, respectively. These results are suggestive, and lead to the speculation as to whether sex differences may grow progressively less distinct, to re-appear at puberty. If such were the case, this might explain the negative findings of investigators who have studied children too old to show the sex differences of infancy and early childhood, but too young to show the sex differences which have been established for adolescent children. Further discussion of this question will be reserved for the next paper of this series.

Sex differences in the coefficient of variation. Table 14 compares the sexes in terms of the coefficient of variation. As in the infant study, the girls show greater variability. Of 122 comparisons of the coefficient of variation, the girls have the higher value in 76 cases, the boys in 46 cases.

The tendency for the girls to be the more variable sex is pronounced at 34 months, and at 69, 78 and 90 months. They lead in inter-iliac breadth, inter-pubic breadth, length of femoral neck, and pubic angle. The boys tend to lead in inter-tuberal breadth, pubis length, and inter-obturator breadth.

TABLE 14

Sex differences in the coefficient of variation.[1]

ITEM	AGE-LEVEL, MONTHS							BOYS	GIRLS	TOTALS
	22	34	45	57	69	78	90			
Pelvis height	G	G	B	B	B	G	G	3	4	7
Pelvis breadth	G	G	G	G	G	G	G	0	7	7
Inlet breadth	B	G	G	G	–	B	G	2	4	6
Inter-iliac breadth	B	G	G	G	G	G	G	1	6	7
Inter-pubic breadth	G	G	G	G	G	B	G	1	6	7
Inter-tuberal breadth	G	G	B	B	B	B	B	5	2	7
Ilium length	G	G	G	B	G	G	B	2	5	7
Pubis length	B	B	B	B	B	G	B	6	1	7
Inlet, sagittal diameter	G	G	–	B	G	B	G	2	4	6
Ischium length	G	B	B	–	B	G	G	3	3	6
Breadth of iliac notch	B	G	B	B	G	B	G	4	3	7
Inter-obturator breadth	B	B	G	B	B	B	G	5	2	7
Bi-trochanteric breadth	G	G	B	G	B	G	B	3	4	7
Length of femoral neck	G	G	G	G	G	G	G	0	7	7
Pubic angle	G	G	B	G	G	G	G	1	6	7
Pelvic angle	B	B	G	G	G	G	G	2	5	7
Femoral angle	B	B	B	–	G	G	G	3	3	6
Femoral-pelvic angle	B	G	B	G	G	B	G	3	4	7
Number of times boys lead	8	5	9	7	6	7	4	46		
Number of times girls lead	10	13	8	9	11	11	14		76	
Totals										122

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[1] The more variable sex indicated by appropriate letter (B or G). Dashes indicate coefficients are equal.

3. *Individual patterns and individual differences in the growth of the pelvis*

The previous sections were based on a statistical treatment of measurements made upon pelvic tracings. The results were in terms of the group — general relationships between variables, growth trends, and sex differences as a whole. Such an analysis of the data, while tedious and time-consuming, does provide results which need not be expressed as unverified opinions, and thus objectifies the impressions which can sometimes be obtained from inspection alone. Young and Ince ('40), in a roentgenologic study of adult pelves, say: "When characters are measurable and expressible in numbers, the knowledge regarding them provided by this method of treatment of the data is likely to be of a much more satisfactory nature." (p. 375.)

Yet it is true, and it is important to demonstrate, that certain conclusions concerning the growth of the pelvis in childhood can be reached by a careful inspection of the roentgenograms, without recourse to any measurements or to any involved statistical procedures. In the present section, therefore, attention will return to the unit of the study, the individual child, whose pelvic development will be examined and compared to the pelvic structure of other individuals.

After tracings of the original roentgenograms are made and checked, all the tracings for each child are assembled, and a so-called "master-tracing" is made. This consists of a figure in which the tracings for an individual child at the various age-levels are superimposed, centered at the point determining the middle of the pubic symphysis, with the lines defining the inlet breadths all parallel. A portion of such a superimposed tracing is shown in figure 6, where tracings at 6 age-levels for the same child may be seen. In the original, distinctive colors are used for each age, making the inspection of the figure far easier.

Figure 6 shows 2 features which seem worth further investigation: first, the steady increase in size of the parts; and second, the impression that a particular type of pelvic conformation is characteristic for this particular child. Size changes are occurring, but these changes appear to take place in a pelvis which maintains a certain individuality of shape.

These impressions are strengthened when a hundred and more of such master-tracings are inspected. A distinctive pelvic shape tends to persist, and after some acquaintance is as identifiable as any other structural feature. Two examples are shown in figures 7 and 8.

In figure 7, a distinct asymmetry in inlet shape, as shown in the tracing, persists at 4 successive age-levels, from 34 through 69 months. In figure 8, the ilia as well as the inlet show asymmetry, in 4 serial roentgenograms, from 69 through 102 months.

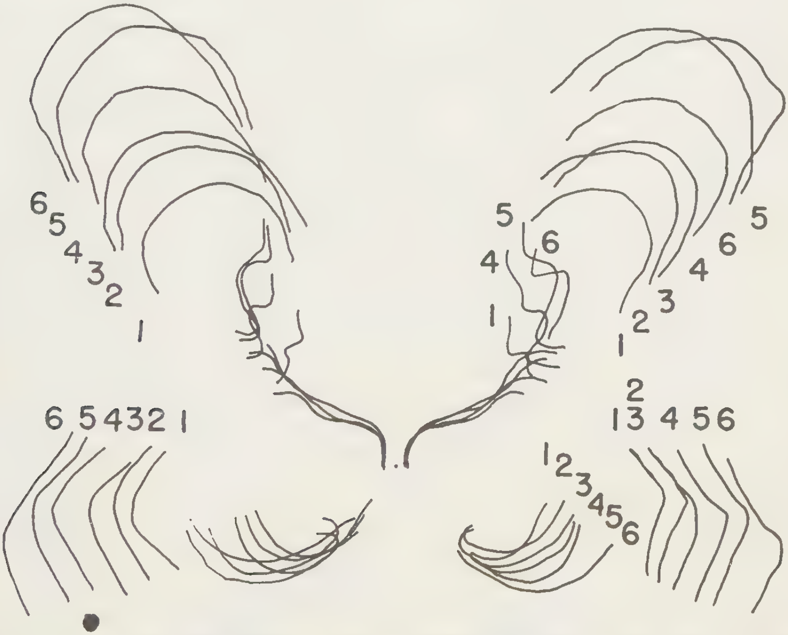

Fig. 6 Superimposed tracings from 6 roentgenograms of the same girl: 22 months (1); 34 months (2); 45 months (3); 57 months (4); 69 months (5); 102 months (6). Only a portion of the original is shown.

In figure 9, a somewhat different type of master-tracing is shown. In this instance, identical twin boys are compared at 4 age-levels, from 69 through 102 months. The right half of figure 9 contains 4 tracings for 1 twin, the left half 4 tracings for the other. In the shape of the ilia and of the inlet the resemblance of the twins is extremely close. The chief difference between them lies in the fact that 1 of the boys

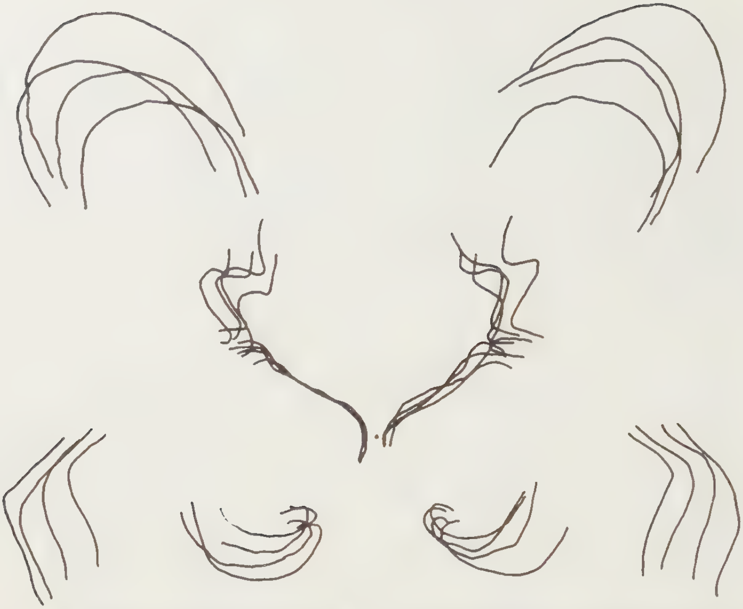

Fig. 7 Superimposed tracings from 4 roentgenograms of the same boy at 34, 45, 57 and 69 months. Note asymmetry in inlet.

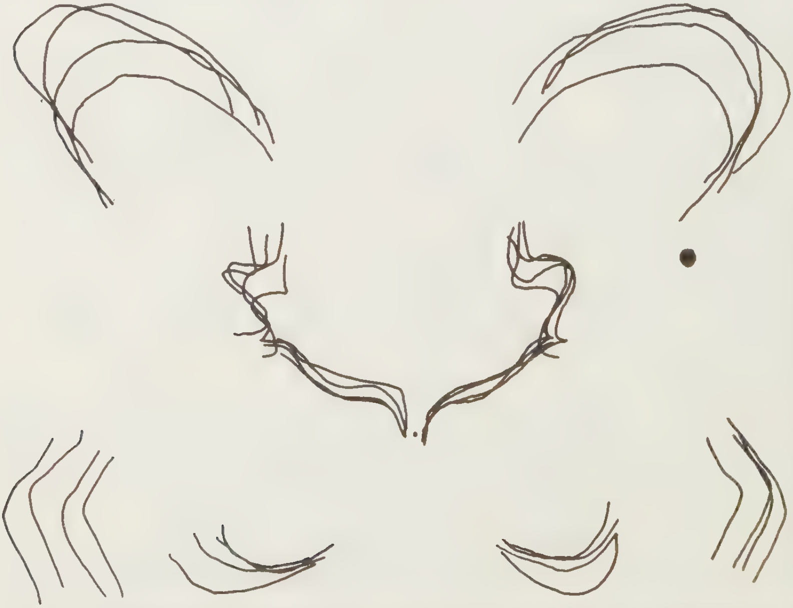

Fig. 8 Superimposed tracings from 4 roentgenograms of the same girl at 69, 78, 90 and 102 months. Note asymmetry in inlet and ilia.

has a slightly more disperse pattern of growth in the lower ischium, and a slightly higher position in the bend of the femur. Figure 9 might, however, easily be taken for the master-tracing of a single individual.

Figure 10 is another comparison of a pair of identical twins, whose 90-month pelvic tracings are superimposed. Close similarity in pelvic shape may be seen; the twin with the slightly larger pelvis is also a trifle larger in body size and is skeletally a little more mature.

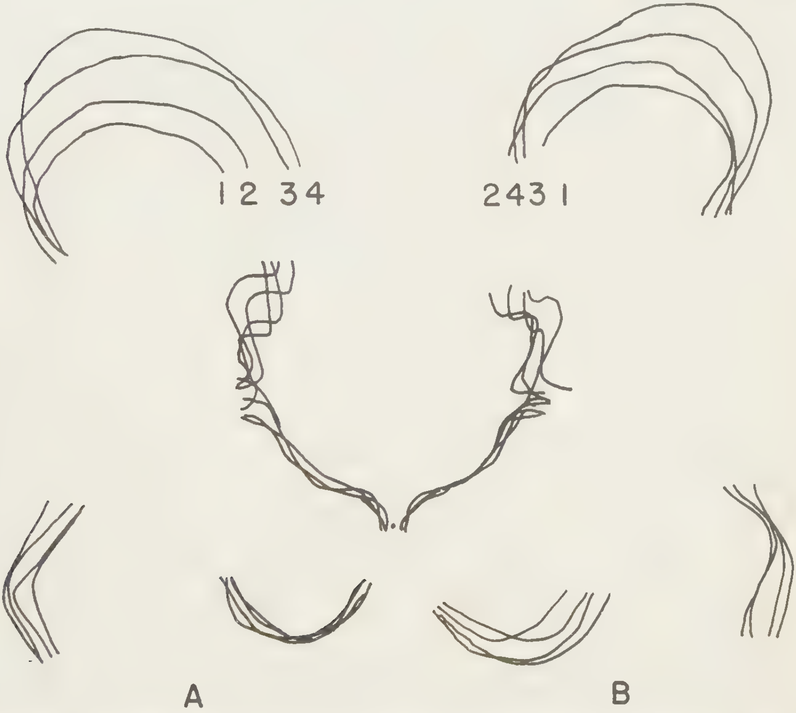

Fig. 9 Superimposed tracings from 4 roentgenograms of identical twin boys at 69, 78, 90 and 102 months. The right side is from one twin, the left side from the other.

Both individual differences and the persistence of individuality in pelvic conformation can be shown by considering smaller areas of the pelvic tracings. In figure 11, the superimposed right ilia taken from a girl's roengenograms at 45,

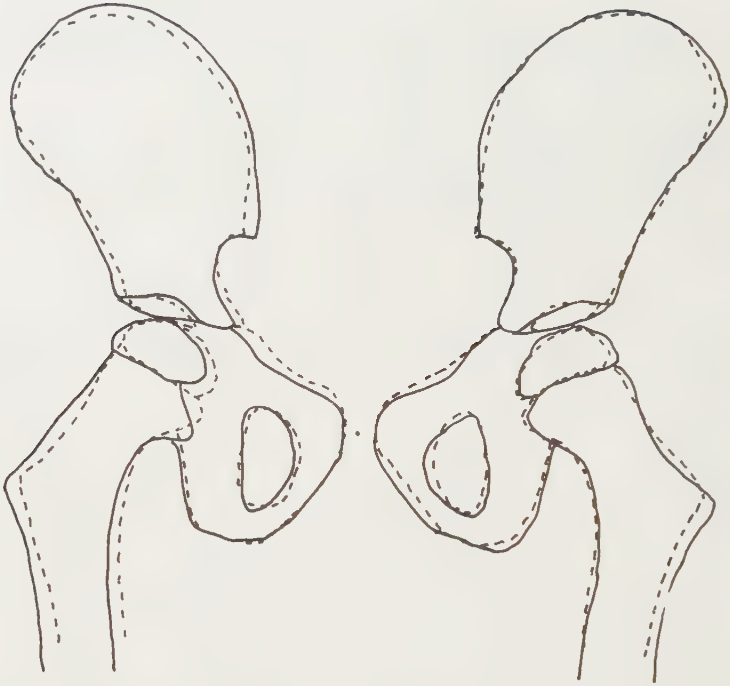

Fig. 10 Superimposed tracings from roentgenograms of identical twin girls at 90 months.

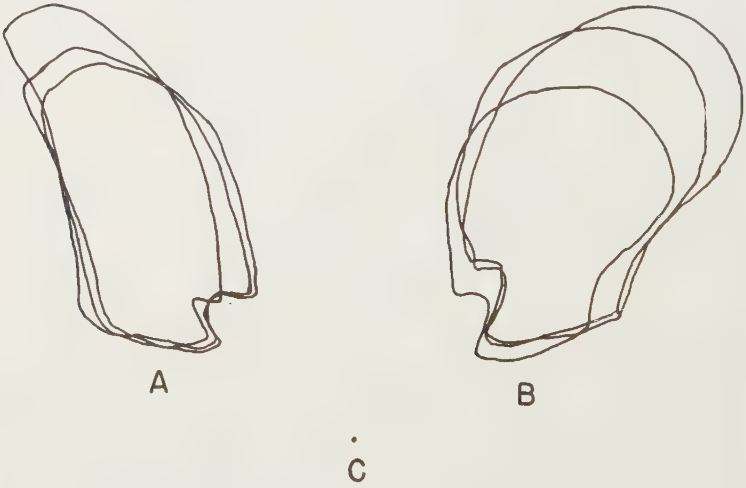

Fig. 11 Superimposed tracings from roentgenograms of 2 girls at 45, 57 and 78 months. The right ilia are from one girl, the left ilia from the other.

57 and 78 months are compared with the left ilia of another girl at the same age-levels.

In figure 12, the left femurs for 2 girls, at 45, 57, 69 and 78 months, are compared. Sharp differences in the bend of the femoral neck (and consequently in the femoral angle) persist through these 4 age-levels.

In figure 13, a comparison is made of the lower portions of pelvic tracings, for 2 girls at 4 successive age-levels. The parts shown include the pubic symphysis, the descending ramus of the pubis and the lower portion of the ischium. A complex of persisting differences is involved: inter-pubic breadth, inter-tuberal breadth, the pubic angle and bi-tuberal breadth all show different patterns of development, involving also such items as height and breadth of the pelvis, the progress toward the junction of the ischium and pubis, and the shape and size of the obturator foramina.

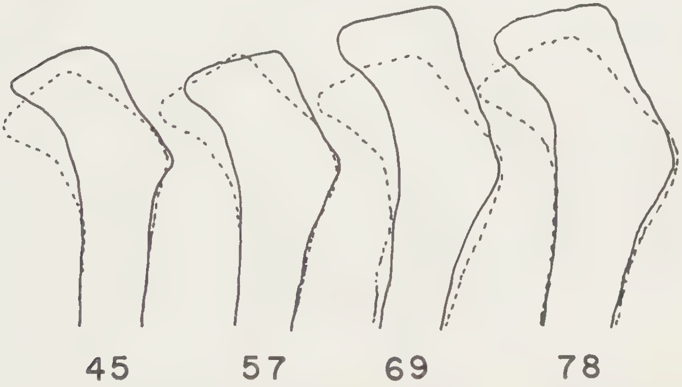

Fig. 12 Superimposed tracings from roentgenograms of 2 girls at 45, 57 69 and 78 months. The left femur is shown.

These few examples emphasize the importance of pelvic comparisons based on inspection alone, and indicate that much information concerning various aspects of pelvic development may be obtained in this manner. On the other hand, the importance of measurements must not be underestimated. Significant sex differences, for example, were demonstrated by the analysis of measurements; such differences are not easily discerned by inspection alone, in the prepuberal stage of pelvis growth. If they were, the present divided opinion on the existence of sex differences would itself not exist.

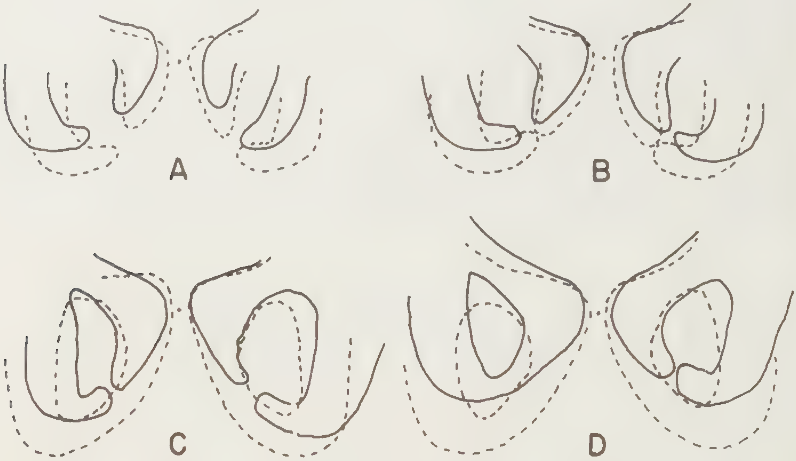

Fig. 13 Superimposed tracings from roentgenograms of 2 girls at 34 (A), 45 (B), 57 (C), and 69 (D) months. Lower pelvic region shown.

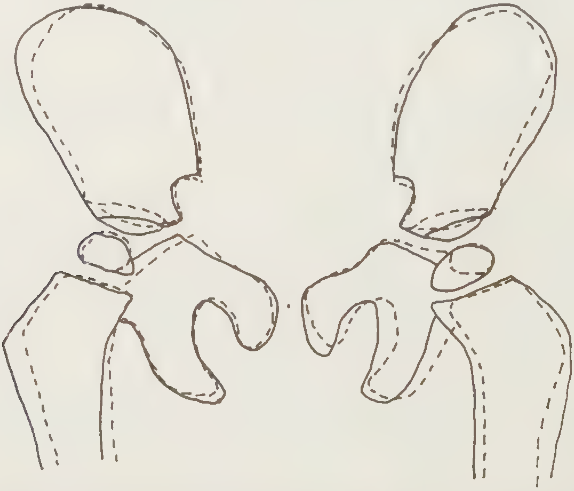

Fig. 14 Superimposed tracings from roentgenograms of boy (solid lines) and girl (broken lines) whose measurements are close to the mean values for each sex at 22 months.

A comparison of tracings for an average boy and average girl of 22 months will look something like figure 14. The differences here are of no great magnitude, and such differences in individual comparisons could be obscured by variations in size, shape or posture. In fact, the sexing of a pelvic tracing from inspection alone is a very uncertain procedure at these age-levels. However, the inability to determine sex in individual cases does not lessen the importance of establishing the fact of sex-differences in the prepuberal pelvis, as a contribution to a fuller understanding of the whole process of growth in the pelvis. The most fruitful approach to the longitudinal study of the development of the bony pelvis seems to lie in the use of both measurements and observations of serial roentgenograms.

SUMMARY AND CONCLUSIONS

This report is concerned with growth changes, sex differences and individual variations in the development of the bony pelvis during prepuberal childhood. It is a sequel to a previous paper on the infant pelvis, and includes most of the children from that study. Conclusions are based both on observations of pelvic roentgenograms, and on the statistical analysis of 22 measurements and indices. The material consists of 640 serial roentgenograms of 92 boys and 91 girls, regular subjects of the Fels Research Institute, between the ages of 2 and 9 years.

The principal conclusions of the present study are summarized by section.

1. Growth changes

1. The intercorrelation of 14 basic measurements shows a rather high pattern of inter-relationship at 34 months. Fifty-seven out of 91 coefficients are statistically significant. Two intercorrelation syndromes exist, 1 of 10 variables, based mainly on transverse measurements, and 1 of 5 variables, including the sagittal diameter of the inlet. The results in general agree with a similar treatment of the infant material.

2. The slowing down of the rate of growth of the pelvis, observed during the first year of life, continues through this period of childhood. This pattern is shown most clearly in the growth curves for pelvis height and pelvis breadth.

3. The coefficient of variation tends to become slightly larger with time in most cases. The behavior of coefficients for individual variables is very similar to the infant study.

4. Significant correlations between measurements taken at 34 months and the same measurements taken at 57 months are shown for many items.

5. Measurements which are taken on both right and left sides of the pelvis are usually highly associated. Significant differences between means of right and left sides are shown by the boys in the femoral angle and the femoral-pelvic angle.

2. Sex differences

1. Girls show higher intercorrelations in measurements at 34 months than boys. This finding is in contrast to the infant study, where the tendency toward higher intercorrelations was shown by the boys.

2. Significant sex differences at 1 or more age-levels are found as follows: Boys lead in pelvis height, pelvis breadth, inlet breadth, inter-iliac breadth, ilium length, ischium length, bi-trochanteric breadth, length of femoral neck and pelvic angle. Girls lead in inter-pubic breadth, intertuberal breadth, pubis length, breadth of iliac notch, interobturator breadth, pubic angle, femoral-pelvic angle and inlet index.

3. Critical ratios of sex differences are larger at 22 months than at any of the 6 succeeding age-levels. There appears to be a tendency for sex differences to become less pronounced with age, during the age period here studied. Implications of this finding are discussed.

4. Measurements of girls tend to be more variable than measurements of boys. This agrees with the results from the infant study.

5. The general pattern of sex differences in the prepuberal pelvis is in agreement with the results of the infant study. The suggestion is again made that, in prepuberal childhood as well as in infancy, boys are larger in measurements relating to the overall structure of the pelvis, while girls tend to be either absolutely or relatively larger in measurements relating to the inner structure of the pelvis, including the inlet.

3. Individual patterns and individual differences in the growth of the pelvis

1. Superimposed pelvic tracings of the same child at different age-levels demonstrate that certain conclusions regarding size increases and individuality of pelvic shape can be reached by inspection alone.
2. Superimposed tracings of roentgenograms of asymmetric pelves at various age-levels show the persistence of a distinctive pelvic structure.
3. Comparisons of pelves of identical twins show close resemblance. Slight size differences which occur are related to general size differences between the twins.
4. Comparison of smaller areas of pelvic tracings illustrate various complexes of persisting differences between children.
5. The results obtained from pelvic measurements are discussed in relation to the information which can be derived from observation alone, and the need for a combination of both methods is stressed.

The author wishes to thank Mary Adams, Jean Anderson, Alfredo Lazario, Mike Stahl and others of the Fels staff, for assistance given at various stages of the study.

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ARTIST'S PICTURE OF A PAPUAN.— Fullface and without his Egyptian bob, [this Suki, a Papuan of the interior,] looked a little less like an ancient Pharaoh than like a deeply tinted rabbi. His face was now, mysteriously, just as dark as the skin of his body. But he was extraordinarily Semitic-looking, even with the same sad-lidded, "hollow" eyes that we associate with a certain "Biblical type" of Jew. To strengthen the impression, his short beard grew in points up his chin with the same good lines repeated in his closely cropped mustache. (The mongoloid Melanesians are almost as hairless as the real Mongoloids, and consequently find hairiness disgusting. One never sees face whiskers among them except on the old men who have grown too indifferent to pluck out their beards.) Withal it was a strong, handsome face, not in the least brutish, and the only departure from "normal" was an extremely high hairline. It looked like growing baldness or as if the hair had been shaved back, but this was normal for Papuans. Even the hair of the woman begins back on the top plane of the head.— Caroline Mytinger. *New Guinea headhunt.* The Macmillan Co., N. Y., 1946, viii + 441 pp. ($4.00).

THE QUANTITATIVE INVESTIGATION OF ABORIGINAL SITES: ANALYSES OF HUMAN BONE

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Division of Physiology, Medical School, and the Department of Anthropology, University of California, Berkeley

ONE FIGURE

INTRODUCTION

In recent months several of us at the University of California have become interested in the exploration of a field which might be termed physical and chemical archaeology. This involves the analysis by physical and chemical methods of the materials composing formerly inhabited sites with the aim of associating both qualitative and quantitative differences with the mode of life and culture of the inhabitants as well as perhaps the time of existence. Some of these methods have been described in previous papers (Cook, '46; Cook and Treganza, in press) particularly with reference to the mound matrix.

One of the materials found in aboriginal sites is human bone, derived from the burial of the dead. This bone, in life an intricate complex of inorganic and organic compounds, undergoes still further modification during its long sojourn in the soil. It should be possible, by systematic yet relatively simple methods, to follow such changes as may have taken place, and thus derive some insight not only into the nature of the alterations, but also into the length of time necessary for them to occur. We have examined here a sufficiently extensive series to make possible the application of elementary statistical procedures.

Although this has been a collaborative investigation we believe it to be desirable to present it in 2 parts, since we are individually concerned with somewhat different aspects of the general problem. Accordingly the description of methods, results, and calculations has been written by one of us (Cook) and the other (Heizer) has discussed these results in terms of their archaeological significance.

METHODS, RESULTS AND CALCULATIONS

The material was drawn from the skeletal remains excavated in the last 10 years by the Department of Anthropology of the University of California and the Sacramento Junior College from sites in the lower Sacramento Valley (fig. 1). For the present analyses there were selected 31 samples, 14 from the Late Central California culture horizon, 10 from the Middle horizon, and 7 from the Early horizon, To these have been added certain data derived from previous work. The data are shown in detail in table 1. The sample designations 1 to 33 refer to the present series. Those lettered A to G were analyzed approximately 10 years ago. Those lettered W to Z were analyzed relatively recently in a preliminary test.

For every sample in the recent, extensive series, a segment of the shaft of the femur was taken. In the earlier tests 1 of the long bones (femur or tibia) was also used consistently. The specimen was cleaned, scraped and freed of adhering soil material. For nitrogen analyses it was then ground to a fine powder. For the calcium and phosphorous analyses small fragments were used. The nitrogen determinations were performed by the micro-Kjeldahl method under the direction of Dr. Cecil Entenman in the laboratory of Prof. I. L. Chaikoff, Department of Physiology. With respect to calcium and phosphorus, the group A to G was analyzed at Sacramento Junior College, the method not known to us. Group W to Z was analyzed in the laboratory of Prof. D. H. Copp, Department of Physiology; Group 1 to

33 was analyzed through the courtesy of the Division of Plant Nutrition, College of Agriculture, University of California. Since both these laboratories have been performing routinely large numbers of calcium and phosphorous analyses, the accuracy of the determinations may be accepted with confidence.

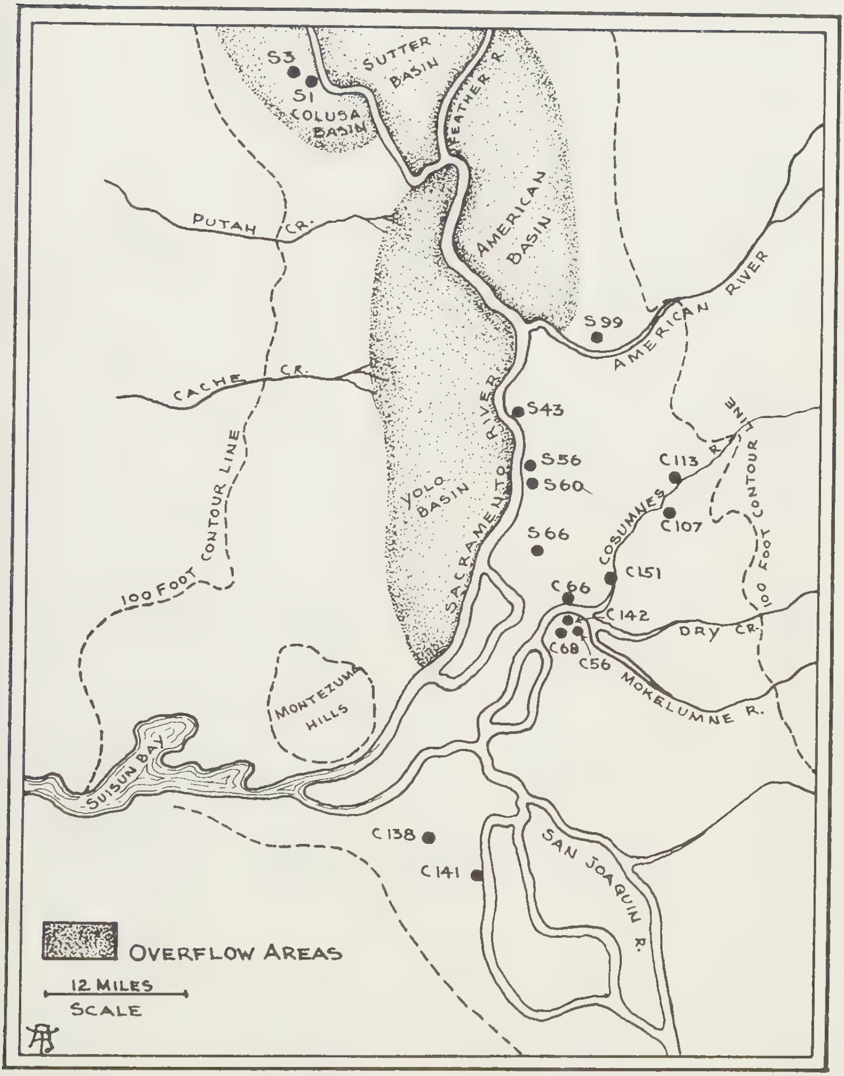

Fig. 1 Map of the lower Sacramento Valley showing locations of archaeological sites mentioned in the text.

TABLE 1

Analyses of 42 bone samples from Late, Middle and Early periods.

SAMPLE DESIG-NATION	SITE	PERIOD	% IGNITION LOSS	% N	% Ca IN BONE	% Ca IN ASH	% P IN BONE	% P IN ASH	$\frac{Ca}{P}$	$\frac{CaCO_3}{Ca_3(PO_4)}$
1	S1	LII	15.7	1.33	33.6	39.7	13.9	16.5	2.4	0.252
33	S1	LII	18.5	1.34	33.7	41.3	13.9	17.1	2.42	0.239
2	S56	LII	21.7	1.98	32.5	41.4	14.2	18.1	2.29	0.178
3	S60	LII	37.7	4.17	25.1	40.5	11.3	18.2	2.22	0.144
4	S86	LII	36.5	4.06	27.1	44.3	11.1	18.1	2.44	0.255
5	S1	LI	18.3	0.90	35.5	43.4	14.1	17.3	2.52	0.291
32	S1	LI	14.6	0.56	36.2	42.4	16.1	18.9	2.25	0.155
6	S3	LI	18.1	0.95	34.1	41.6	13.2	16.1	2.58	0.322
7	S3	LI	20.9	1.04	33.8	42.7	12.7	16.1	2.66	0.360
8	S60	LI	33.7	2.44	27.8	42.0	11.7	17.7	2.37	0.213
9	S66	LI	30.5	2.58	28.0	40.2	15.2	21.8	1.84	—0.047
10	S66	LI	18.3	1.26	34.5	42.2	14.4	17.6	2.40	0.224
26	C138	LI	18.5	1.43	33.1	40.6	18.9	23.2	1.75	—0.091
11	C138	LI	30.4	2.15	29.7	42.7	12.1	17.4	2.45	0.259
A	C107	LI							2.60	
B	C107	LI							2.30	0.191
C	C107	LI							2.31	
12	C151	M	15.5	0.37	37.9	44.8	13.9	16.5	2.73	0.367
13	C151	M	18.8	0.75	36.2	44.7	12.5	15.4	2.90	0.485
14	S43	M	14.5	0.28	33.7	39.5	14.1	16.5	2.39	0.223
15	S43	M	23.9	1.69	31.3	41.2	13.1	17.2	2.39	0.222
16	S60	M	25.0	1.80	31.0	41.4	16.1	21.5	1.92	0.000
17	S60	M	16.2	0.52	35.7	42.6	14.7	17.6	2.42	0.239
18	S99	M	17.4	0.82	36.0	43.5	14.8	17.9	2.43	0.241
19	C66	M	24.7	1.86	31.4	41.8	13.7	18.2	2.29	0.179
20	C113	M	22.3	1.25	33.2	42.7	13.4	17.2	2.48	0.268
29	C142	M	27.3	2.22	31.4	43.2	13.7	18.8	2.29	0.176
21	C56	E	19.3	1.02	34.0	42.0	14.6	18.0	2.33	0.198
22	C56	E	11.3	0.06	36.8	41.6	15.5	17.5	2.37	0.221
23	C68	E	17.9	0.31	35.9	43.7	13.6	16.5	2.64	0.348
24	C107	E	17.9	0.54	36.1	44.0	13.4	16.3	2.69	0.381
25	C107	E	19.1	0.66	35.4	43.8	13.5	16.7	2.62	0.340
27	C142	E	14.7	0.34	36.4	42.6	13.7	16.0	2.66	0.366
28	C142	E	15.6	0.53	37.4	44.3	13.2	15.6	2.83	0.447
D	C142	E							3.04	
E	C107	E							3.18	
F	C107	E	20.2		36.9	46.6	11.7	14.8	3.15	0.606
G	C107	E							3.14	
W	C68	E	23.8		27.7	36.4	9.6	12.6	2.89	0.481
X	C68	E	16.5		34.1	40.7	12.5	14.9	2.73	0.422
Y	C68	E	9.4		37.2	41.1	14.1	15.6	2.64	0.356
Z	C68	E	18.2		34.1	41.7	12.8	15.6	2.66	0.367

On inspection of table 1 it is immediately apparent that there is great variability in the values for individual bones. These variations arise from several sources. The purely experimental error is doubtless small for in the case of the nitrogen determinations and the calcium and phosphorous analyses duplicate checks were made to establish the accuracy of the method. The inherent variations include first the possible differences in mineral content of the bones of the individual persons at the time of their death. If the pre-mortal diet had been seriously deficient in calcium or phosphorus the osseous remains could show abnormalities. In a random selection throughout a large population, however, the probability of such deviations would be small. Indeed, in the absence of any clear indication to the contrary, we can assume that pathological conditions are not involved.

The second intrinsic source of variation is the physical and chemical environment of the bone subsequent to interment. These fragments, after decomposition of the fleshy portion of the cadavers lay surrounded by the matrix of the burial site, exposed to the action of soil water and its solutes for very long periods of time. Solution, precipitation, replacement of elements could then occur within the bone structure, processes which would continue relatively slowly but persistently. Quantitative as well as qualitative changes would then depend upon the composition of the soil and the concentrations of the existing materials. Hence the final result might vary from site to site or even from place to place within a single site. In order to evaluate properly these causes of deviation it would be necessary to know both the physico-chemical characteristics of the mound matrix and the quantitative interaction between the latter and the bone substance. Since neither of these categories of information are at present available to us, we are forced to accept the data with the recognition that they contain a large element of uncontrolled variation.

The third source of difference, and the one in which we are here primarily interested is time. The hypothesis may be set up for working purposes that there are certain alterations of very general occurrence which are proceeding to a greater or lesser extent in all Central Californian prehistoric sites and which are continuous in time. To test the validity of such an hypothesis it is necessary to minimize the influence of local spatial variation by examining a sufficiently extensive series of bones taken from numerous sites.

In table 2 the mean values for our samples are given with respect to the generally recognized 3 primary periods: Late, Middle and Early. The significance of these means is shown in a reasonably accurate fashion by the critical ratios of the means, as calculated by standard elementary statistical methods. For the numbers of samples here involved no value smaller than 2.5 can be regarded as of material significance. (That is to say, the mean differences are likely to have been due to chance.) If the value lies between 2.5 and 3.0 there is a fair probability that there is a real difference and if above 3.0 the probability is high that the difference between the means is not to be ascribed to chance alone.

TABLE 2

Mean values by period.

PERIOD	% IGNITION LOSS	% N	% Ca IN BONE	% Ca IN ASH	% P IN BONE	% P IN ASH	$\frac{Ca}{P}$	$\frac{CaCO_3}{Ca_3(PO_4)_2}$
Contemporary (dry bone)	40.00	4.08	25.00	36.00	11.40	16.00	2.20	0.157
Late, Phases I and II	23.81	1.87	31.76	41.79	13.77	18.15	2.33	0.208
Middle	20.56	1.16	33.78	42.54	14.00	17.68	2.43	0.240
Early	17.00	0.49	35.16	42.37	13.18	15.84	2.68	0.378
Critical ratio (Late: Early)	2.81	4.28	2.82	0.52	0.83	3.35	3.77	3.79

It will be noted that the critical ratios are given only between the Late and the Early samples. Where these ratios show significant differences, however, the value for the Middle period lies between the other 2. This is further presumptive evidence for the existence of a definite trend from Late to Early. Where the critical ratio is low, as in columns 5 and 6 of table 2 the Middle value does not fall between Early and Late. Therefore in these cases there is no progressive temporal change visible. For the remaining columns presumably highly significant differences could be obtained between Middle and Late or between Middle and Early provided sufficient samples were employed. The number necessary would, however, be so great as to necessitate tremendous labor and expense. The general picture is reasonably clear from the existing sample number.

Fresh human bone, freed from marrow and thoroughly dried, consists of approximately 40% organic material. Since there is no carbohydrate the latter consists of protein and fat. The fat content probably amounts to 3–4%. This question was investigated some years ago by Gangl ('36) who reported that fat persists in bone for several thousand years after burial. His material was derived from early historical sources in Europe. We examined 4 samples (not included in the present series) from Late and Early sites in California. The analyses were performed under the direction of Prof. I. L. Chaikoff of the Division of Physiology, University of California, who has developed very precise methods in this field of investigation. In none of our samples was he able to detect any fatty acids, even in bone from relatively late sites, within the limits of experimental error. For our purposes, therefore, Gangl's method may be definitely excluded.

The protein consists almost wholly of ossein, or bone protein. The relation between protein and its average nitrogen content is usually expressed as the ratio 16:1. Deducting 4% for fat, the organic content of dried bone being 40%, the protein should be 36% and the nitrogen content 2.25%. The value we have obtained for a normal human femur, derived from a fresh cadaver, is 4.08% and the 2 Late aboriginal femurs showed 4.06 and 4.17%, respectively. It is necessary to conclude, therefore, either that the nitrogen ratio for ossein is lower than 16:1 or that in dead bone, even of extremely recent origin, other compounds of high nitrogen content are present. Nevertheless in either contingency it is probable that at least a large portion of the total nitrogen is in the form of protein.

From the preceding discussion it is clear that the loss of weight observed on ashing dry bone is due primarily to the combustion of organic material, in particular protein, and perhaps other nitrogenous compounds. The balance will be referable to the decomposition of carbonates with removal of CO_2.

The data in table 2 show that the mean ignition loss with aboriginal bones from the Late period is slightly more than half (23%) what would be expected with freshly killed bone (40%). There must consequently be a relatively rapid loss of organic matter in the years or decades immediately following interment. This is accounted for by disappearance of fat and some of the protein. With further aging there is a continued loss such that the mean of the early bones is 17%, but the reduction appears to be relatively slow. The appearance may be somewhat misleading, however, since with age there tends to be an increase in carbonates which, on ignition, would be lost along with organic matter.

A more valid criterion than ignition loss is the nitrogen content. Taking the latter as 4% for normal, or freshly killed bone, it will be observed that the mean value for the Late period is 1.87% and for the Early period 0.49%, a much more profound change than is evident from the ignition loss. However, the striking feature demonstrated by these data is not the rapidity with which nitrogen disappears but the fact that it persists in measurable quantities as long as it does. If one examines the individual analyses for 5 samples from Late period, phase II, none of which can be less than 100 years old, he will notice very wide variation in nitrogen content. Some of the bones have lost much of their nitrogen yet 2 (nos. 3 and 4) have retained substantially the normal, living amount. Among the samples from the Early period, which must be measured by at least a few thousand years of age, only 1 specimen (no. 22) can be said to have lost all its nitrogen. We tested 2 samples qualitatively for protein, no. 3 and no. 27, by the colorimetric method of Folin-Ciocalteu ('27). No. 3 yielded a very heavy, intense color. No. 27 showed clear traces. There can be no question, therefore, that some, at least, of the nitrogen in the entire series of samples is in the form of protein, or perhaps peptides or amino acids.

These findings create certain problems, perhaps of more interest to the biochemist and micro-biologist than to the archaeologist. Why have not soil and putrefactive bacteria long since eliminated all organic matter from bone as they do from the fleshy parts of dead organisms? Is it possible that they are not able to penetrate the interstices of the mineral framework of the osseous structure? Apart from bacterial action is, or is not, protein subject to slow hydrolysis and oxidation, assuming moisture and oxygen to be present? What intermediate or degradation products are present? What is the rate of leaching or diffusion of soluble compounds? Is there any compensating inward movement of organic materials from the mound matrix? Only an extensive and careful investigation can answer these questions.

Insofar as time relations are concerned it can be stated that a progressive loss of total nitrogen occurs which is not yet complete in our earliest osseous remains. Although no single contextless sample can be referred with certainty on the basis of a laboratory analysis to a particular period, due to the local sources of variation previously mentioned, it is possible that an adequate number of samples from a single site could prove strongly indicative of the relative position in the temporal sequence.

The analyses of inorganic constituents pertain to the presence and relative abundance of calcium and phosphorus, carbonate and phosphate.[1] In living or freshly killed bone, calcium and phosphorus exist almost exclusively in the form of tri-calcium phosphate. The average composition for dry bone is usually stated as being 25% for calcium and 11–12% for phosphorus, with an element ratio Ca : P of 2.2. The corresponding values for bone ash are 36%, 16% and a ratio of 2.0. These figures are to be regarded as only approximate since even with modern analytical methods there still exists considerable disparity in results from different laboratories and with different experimental material.

The data in table 2 indicate that the 2 elements under consideration are present in late aboriginal bones in greater quantity than in normal osseous tissue. This finding is directly referable to the loss in organic matter. However, the same relationship seems to hold in ashed bone. Here the loss in organic matter cannot be invoked as an explanation and indeed the reason is not readily apparent.

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[1] The presence and relationships of these elements and compounds has to some extent been previously investigated. A. F. Rogers ('24) reported on fossil bone. He stated that the latter contained a mineral which he designated *collophane*, consisting of a "hydrous calcium carbonate-phosphate." The formula is $CA_3(PO_4)_2 \cdot n\ CaCO_3 \cdot H_2O$ where "*n* has the limiting values 1 and 2" (p. 536). Since fresh bone contains almost exclusively $Ca_3(PO_4)_2$ without carbonate, the process of fossilization would appear to consist of an addition, molecule by molecule, of $CaCO_3$, or, preferably, the substitution of CO_3 for PO_4 with no alteration of the calcium content. In highly fossilized material Rogers maintained that there had been a heavy replacement of calcium by iron, aluminum and magnesium and of carbonate by fluoride and sulphate. We have not analyzed specifically for these substances, although such analyses would be desirable if the present investigation is pushed beyond its existing limits. It should be pointed out, however, that profound modification through such replacement would (1) require the lapse of greater time intervals than those with which we are dealing, and (2) be contingent upon the chemical nature of the matrix in which the bone was embedded.

A. E. Jenks ('36, pp. 35–36) utilized some tests derived from the work of Rogers. These were directed only toward deciding whether the Minnesota bones were or were not fossilized. No attempt was made to establish any time scale by quantitative determinations with a series of bones. The entire technique was subsequently called in question and severely criticized by F. G. Hawley, '37, who quite correctly pointed out that carbonization on heating and effervescence with nitric acid are purely qualitative tests for organic material and for carbonates which would be as effective with new as with old bone. Tests were also obtained "for calcium and the phosphate radical" (Jenks, '36, p. 35). But since no apparent attempt was made to assess the crucially important relationship between the quantities of calcium and phosphate (and carbonate) these tests can scarcely be regarded as critical for estimating the absolute age of the bone.

Examining the temporal trend among the samples it will be seen that within statistical significance the calcium in bone increases with age, the phosphorus in bone remains essentially unchanged, the calcium in ash remains constant, the phosphorus in ash decreases and the ratio Ca : P increases. Bearing in mind that the net weight of the entire bony structure is decreasing due to loss of the organic components one observes that actually the total calcium content remains substantially unchanged while there is a slow but definite disappearance of phosphorus. This may be explained by assuming simply a slow decomposition of the original tricalcium phosphate to form soluble phosphates and the gradual leaching out of the latter into the surrounding soil. However, the kinetics of this process will be dependent *inter alia* upon the phosphate content of the ground matrix, together with the availability of other cations with which the bone phosphate may combine. Here again we encounter the desirability of knowing the composition of the mound substance itself.

If the bone phosphate is depleted as the values in column 7, table 2, seem to indicate, the remaining calcium will combine with the carbon dioxide which will always be present in small quantities to form calcium carbonate. Hence if the ideas here expressed have validity not only should the Ca : P ratio increase with age but also the ratio of $CaCO_3$ to $Ca_3(PO_4)_2$. These later ratios have been calculated and are shown in the last columns of table 1 and table 2. The calculation was made in each case, using molecular equivalents, and the observed percentages of calcium as (CaO) and phosphorus (as P_2O_5) in whole bone. It is a fair assumption that practically all the phosphorus present is combined with calcium. Then the calcium in excess of what would be necessary for this reaction must be in the form of carbonate. The same type of calculation could be made if one assumed the total phosphorus to remain constant through time, i.e., that no leaching of phosphates occurred, while the calcium gradually increased. This concept would be in line with the statement, often verbally expressed, that these bones become ''mineralized'' with the implication that there is a net increase of total inorganic content. But the idea is disproved by the finding that in the ash the calcium does not increase whereas the phosphorus decreases. That the process is rather one of phosphate removal and substitution by carbonate is further supported by density determinations. If there were a general and consistent addition of new material, the density should increase with age. Determinations of this property on the long series of 31 samples showed average values as follows: Late, 2.27; transitional, 2.46; Early, 2.44, the differences between the means all being non-significant.

The carbonate: phosphate ratio of normal bone is approximately 0.16. Those for the 3 cultural periods in Central California are respectively 0.208, 0.240, 0.378. Clearly, therefore, there is a progressive increase of $CaCO_3$ with respect to $Ca_3(PO_4)_2$.

There emerge from the data just presented 2 more possible criteria for estimating the relative age, the ratio Ca : P and the ratio carbonate : phosphate. Since the 2 are almost perfectly correlated ($r = +0.95$) only 1 would be necessary in practice. The direct ratio of elements involves less computation and is probably the more satisfactory.

Concerning absolute age no definitive conclusions can be drawn. Nevertheless it may be of interest to indulge in speculative calculation. If the composition of bone among the prehistoric inhabitants was the same as that of modern man, and there is no reason to suppose it was not, the most rapid alterations appear to have taken place soon after burial. If the reactions involved, or the change in concentration of analyzable constituents, followed a linear progression, and if we suppose the mean age of the Late period samples to be 500 years, then the average age of the Early period specimens would not be greater than 1000 years. This conclusion is not supported by any other evidence. Alternatively we may suppose that the velocity of alteration was some function of the concentration of the existing components and that the time course of disappearance or replacement proceeded exponentially in a manner similar to the decrease of a substance undergoing a monomolecular decomposition or radioactive decay.

If, using this approach, the figures for normal bone are taken as the starting point, the values for the mean Early period still fall between 1000 and 2000 years. However, if it be desired to exclude possible rapid changes directly following interment the segment of the curve from mean Late to mean Early can be considered. Certainly during this interval only low velocity reactions and processes can have been proceeding. We employ the standard formula in the form $t_2 - t_1 = \frac{1}{K} \log_e \frac{C_1}{C_2}$ where t is time and C observed concentration or quantity of substance. The age of the sample mean for the entire Late period (I and II) may reasonably be placed at 500 years ago. The same factor for the Middle horizon is a matter of personal estimate. Suppose, however, it were put at 2500 years ago. Then $t_2 - t_1$ would be 2000 years. The value of the constant K can then be calculated, and with it, by the proper substitutions, the value of the mean sample age for the early period.

As would be expected the items dealt with here give quite widely varying results: ignition loss 2,550, nitrogen 11,650, phosphorus in ash 7,800, Ca:P ratio 3,000 and ratio $CaCO_3 : Ca_3(PO_4)_2$ · 17,500. The average is 10,500 years, or, adding the 500 years to the mid-Late period, 11,000 years ago. If the Middle period is put back to 4,500 years, then the date for the mid-Early period becomes 21,500 years.

The point does not need emphasis that a tolerance of 1,000 to 21,500 years, depending upon the assumption one wishes to make, is of no great assistance to the archaeologist. Nevertheless the far higher probability that an exponential relationship exists, rather than a linear relationship, lays upon the archaeologist the necessity of considering seriously the longer time intervals.

ARCHAEOLOGICAL DISCUSSION

The accompanying presentation of data by Cook represents an avenue of inquiry into the important question of chronology in a region where time estimates are notoriously resistive of demonstration. Archaeologists, who themselves have been unable to do more than build relative chronologies based upon stratigraphic evidences, must inevitably turn to other sciences for aid. A. E. Douglass, an astronomer, who established dendrochronology, de Geer, and other glaciologists who determined the varve chronology come to mind as men who have through their work made it possible to develop exact time sequences in archaeology. It is because I think that Cook is on the trail of something which may turn out, with more work, to be a new chronological method that I have encouraged him to publish his results even though they do not now rise to the level of a simple formula or scale which may be used to place a Central California archaelogical site or culture horizon in terms of year dates.[2] Indeed, laboratory analyses of bones may never yield this result, but because already the method is outlined, and the question of investing the variable chemical analyses with an age factor has presented itself, we feel that it is desirable to offer this preliminary statement.

The archaeological outlines of the Central California region have been steadily becoming clearer in the last decade. Three major cultural-temporal horizons have been determined, and within these divisions it is now possible to isolate a number of "provinces" and "facies."[3] The accompanying culture classification chart represents our conclusions to date as far as cultural and temporal relationships are concerned.

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[2] Thus far, this project is being carried out jointly by the Departments of Anthropology and Physiology, University of California. Funds used came from the Department of Anthropology Research Fund no. 217 granted by the University Committee on Research.

Sites in the Interior Valley zone are in the form of mounds composed of accumulation refuse, generally circular in outline and lenticular in cross section. The historic environment of river flooding and sedimentation of the valley floor has a considerable time depth here, for the alluvial sediments are to be measured in hundreds of feet. Since the time of man's earliest presence in this favored environment he has had to seek high places on which he could escape submergence by flood waters.[4] The long term result has been that successive cultural groups have repeatedly selected settlement spots occupied by former groups, and a large percentage of sites are stratified. It is my impression that site locations, stratification, and drainage have little to do with chemical alteration of human skeletal material. Site C.107 rests on a high clay knoll which rises out of the flood plain of the Cosumnes River. The surface of the clay dome (in which are found the Early culture horizon burials) has always been above the reach of flood waters. Sites C.142, C.56, and C.68, on the other hand, lie on or near the sea level contour and have, in the course of time since they were occupied by the Early culture horizon group, undergone depression while the valley floor was receiving overflow sediments. These 3 sites have probably been submerged repeatedly by flood waters and subjected to groundwater solutes for a very long time. Yet the analyses of bones from these 4 sites are collectively different from any other group of sites. The external and internal conditions of

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[3] This classification was devised in a series of informal conferences at Berkeley through necessity for a more refined system than our original one which identified sites as of either Early, Transitional (Middle), or Late culture. This threefold sequence, which is still the basic framework, has been divided into provinces (geographical-cultural areas) and subdivided into facies (equivalent to the "focus" of eastern prehistory), which are aggregates of "settlements" or "communities" (the "component" of the Midwestern taxonomic system).

[4] The early Caucasian settlement pattern (1840–1880) was also determined by these factors, and almost without exception houses and barns built in this period were placed atop aboriginal sites. River levee construction from the late nineteenth century onward eliminated the necessity of building on elevated spots.

CHART 1

Classification of cultural and temporal relationships for Central California.

<table>
<tr><th colspan="2"></th><th colspan="2">LITTORAL ZONE</th><th colspan="5">INTERIOR VALLEY ZONE</th></tr>
<tr><th colspan="2"></th><th>Alameda province</th><th>Marin province</th><th colspan="2">Delta province</th><th colspan="3">Colusa province</th></tr>
<tr><td rowspan="2">LATE CENTRAL CALIFORNIA HORIZON</td><td>Phase II</td><td>Fernandez facies</td><td>Estero facies</td><td colspan="2">Mosher facies
Settlements
S.56
S.60
C.138</td><td colspan="3">Miller facies
Settlements
S.1</td></tr>
<tr><td>Phase I</td><td>Emeryville facies</td><td>Mendoza facies</td><td colspan="2">Hollister facies
Settlements
S.60 C.107
S.66
C.138</td><td colspan="3">Sandhill facies
Settlements
S.1
S.3</td></tr>
<tr><td colspan="2" rowspan="2">MIDDLE CENTRAL CALIFORNIA HORIZON</td><td colspan="2">Coastal province</td><td colspan="5">Interior province</td></tr>
<tr><td>McClure facies</td><td>Ellis Landing facies</td><td>Morse facies
Settlements
S.60
S.66
C.113</td><td>Deterding facies
Settlements
S.99</td><td>Brazil facies
Settlements
S.43</td><td>Need facies
Settlements
Need</td><td>Orwood facies
Settlements
C.141</td></tr>
<tr><td colspan="2" rowspan="2">EARLY CENTRAL LIFORNIA HORIZON</td><td colspan="2" rowspan="2">(Unknown)</td><td colspan="5">Unnamed province</td></tr>
<tr><td colspan="5">Windmiller facies
Settlements
C.107
C.68
C.56
C.142</td></tr>
</table>

mound deposits do, no doubt, have definite effects upon alteration of chemical constituents in bone, but the reasonable conclusion *seems* to be that the time factor is more significant than any of the other modifying conditions. This is stated with the reservation that further laboratory work along the lines indicated by Cook may definitely demonstrate or disprove the specific effect of these several factors. What is most difficult to explain is the variation in chemical content between bones of the same time period within a single site. Only series analyses of bones from single sites will furnish an explanation of this variable.

What does appear significant and that which seems to me to offer promise is table 2, which is a summary of the means of the figures in table 1. Here Early, Middle, and Late appear for most values to be set apart from each other. I should have expected the analyses from the Early culture horizon deposits to show a greater difference from those of the Middle horizon on the basis of what appears to us to be a time gap between the Early and Middle horizon periods. Perhaps the archaeologist is wrong in his interpretation, but an alternative explanation is that of Cook who suggests an initially high rate of alteration which subsequently proceeds at an ever decreasing tempo. In other words the archaeologist's interpretation of a temporal hiatus between Early and Middle is not ruled out, but must be tested by further extensive analyses.

Cook's concluding paragraphs explore the possibilities of using chemical analyses of bone as a basis for dating. He believes, as I do, that we should have a much larger series of determinations to manipulate for a serious discussion of this aspect of the problem. So long as we stay within the Central California physiographic area and deal with bones from sites of known culture horizon, there are enough constants to make all the data comparable.[5]

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[5] Similar series from outside would be interesting to compare with the Central California series, but it is probable that if a chronological method gives results which could conceivably be applied to open sites in a region which has a long historical span of successive cultures, the technique would have to be applied in each new region, and the local time scale there based upon those features and modifying factors which seemed significant.

As Cook shows, the assumption that the reactions involved or changes in concentration of chemical constituents followed a linear progression presents us with an age for the Early horizon burials of not more than 1000 years. This can hardly be the case, since we have many evidences that this culture was operative much earlier than 900 A.D. These evidences I will not detail here, but they are overwhelmingly against this last date. This is unfortunate, since we have some hopes of being able to date, by cross-chronology with other regions, our Late horizon Phases I and II culture manifestations. The elimination of the linear progression of bone alteration from the time of burial on through time, to the Early horizon makes it necessary to look for some other known time point beside the historic period of ca. 100 years ago. The older work of N. C. Nelson ('09, '10) and E. W. Gifford ('16) on rates of shell-mound accumulation, recently reviewed and re-calculated by S. F. Cook ('46) has yielded an age "date" for the San Francisco Bay shellmounds of about 3000 years. We can place the oldest Bay shellmounds (Ellis Landing, lower levels of Emeryville, Stege, West Berkeley and others) as of the Middle Central California culture horizon. On the reasonable assumption that the nearby Interior Valley Middle horizon site deposits are of equivalent age, we may for estimative purposes allow Cook's present figure of the Middle horizon culture as operating 2500 years ago. But age calculations, using the 2500-year datum, give results for single chemical constituents which vary between 15 millennia, certainly a range not adapted to immediate application in site dating. The average figure of an 11,000 year lapse seems to me excessive, since I have just completed an analysis of the Early Central California culture and arrived at an estimate of its age in the neighborhood of 4,000 to 5,000 years. I am not saying that my guess is better than Cook's mean, and a number of soil chemists, geomorphologists, and geologists who have seen our Early horizon sites have suggested an antiquity in the neighborhood of 10,000 years. These estimates we have always regarded as intuitive guesses, but perhaps they were hitting closer to the mark than we supposed. No person with archaeological experience who has seen these sites has doubted that they are very old, and the physical type, which is of the "Paleo-Indian" variety, as well as the culture, which fits into the general and widespread "archaic" classification, offers support to the impression of considerable age. Cook's concluding paragraph is a concrete suggestion for the archaeologist to look at the Early Central California culture horizon as relatively ancient rather than relatively recent. Perhaps with more work he will be able to suggest a more precise date range to shoot at.

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Gene Equilibria in Populations.— The study of human genetics is, in the final analysis, essentially a study of population genetics.

One of the important concepts of population genetics is that of equilibrium. A common misconception regarding genetic traits is that a character dependent upon a dominant gene will in time increase its proportion in a population merely because the gene is dominant. Actually it will not. As long as all individuals in a large population have equal opportunities to produce viable offspring, a dominant gene will not increase in frequency with respect to its recessive allelle in the absence of mutation and selection. Rather the two (or more) alleles will maintain constant frequencies from generation to generation. Moreover, under a system of random mating where all individuals have equal opportunities of producing viable offspring, the frequencies of the genotypes produced by a gene and its alleles will not change either, but will likewise remain constant from generation to generation. . . .

The discerning reader will have realized that the so-called human races are populations in the sense in which I have been using the word. As far as we can discover, most of the known human alleles are represented to some extent in all races which have been studied. Therefore such racial differences as are due to genes come about largely as a result of variations in the frequencies of alleles from race to race. Such interracial variations are often less significant than the variations within a single race. It is conceivable that a certain allele might not be represented at all in a particular race, but such circumstances are certainly not common. Races differ in the *frequencies* of various alleles, and obviously it would be most unlikely that any one race would happen to have high frequencies of all the "desirable" genes and another race have high frequencies of all the "undesirable" genes.— (H. J. Muller, C. C. Little and) Laurence H. Snyder. *Genetics, Medicine, and Man.* Cornell Univ. Press, Ithaca, N. Y., 1947, ix + 158 pp. ($2.25).

COMPILATION OF GROWTH DATA.— Due to the war, nearly 8 years have intervened between the completion of the manuscript and the recent distribution in the United States of the printed copy of Dr. W. M. Krogman's "Growth of Man" (Tabulae Biologicae, The Hague, vol. 20, 1941, vi + 963 pp.). This monumental publication, which covers only the period from 1926 to 1938, is a solid mass of tabular material, assembled without comment, but with a list of references and a full index.

BRIEF COMMUNICATIONS

SPECIFIC AND RACIAL CHARACTERS IN HUMAN EVOLUTION

The subject of species has always been a controversial one in biology, and in mankind it has theological aspects. This is no doubt why many anthropologists have preferred to adhere to the usage of Linnaeus in regarding all the living so-called races of mankind as belonging to one species. Many of those who adhere to the view that God created man in his own image would regard it as impious to recognize that the various images mirrored in the human races were sufficiently different to be regarded as species. In a recent article in this Journal Weidenreich ('46b) would go even further, for he not only adheres to the eighteenth century dogma of Linnaeus, but he tells us that in the whole evolution of the Hominidae there has never been more than one species at any one time.

In the paper referred to, Weidenreich has made a reply to a paper of mine (Gates, '44) in which some reasons were given for recognizing several living species of mankind, not to mention several genera and species of fossil man, many of which are generally recognized by anthropologists. Weidenreich even quotes with apparent approval the reduction of all types of fossil man to that outworn expression *Homo sapiens fossilis*. He also refers without dissent, to Testut's early treatment of all anomalies of the human muscular system as "atavisms."

As the whole subject of species in man has been dealt with at some length in my book, *Human Ancestry*, which is now in the press, it will only be necessary here to refer briefly to a few of the points which Weidenreich raises in his paper. Having no wish to detract in any way from the great contributions which Weidenreich has made to human paleontology, it is nevertheless necessary to say that this paper, which is a departure from the anatomical field in which his great discoveries and descriptions have been made, is a perfect example of muddled thinking. Not one of the features by which anthropologists distinguish the races of man, such as stature, head shape, pigmentation and hair characters, is discussed or even mentioned in this connection.

Instead, Weidenreich considers the lower jaw at some length as a variable structure which does not differentiate the racial types. It would have been almost equally cogent to cite the fact that all racial types normally have 5 fingers and to conclude therefrom that all the races are one.

The lion and tiger, which every zoologist recognizes as distinct species, although they intercross, are cited (p. 417) as though they contrasted with the human "races." Yet Weidenreich (p. 423) states in another connection that "A lion and tiger, whose hides have been stripped off, are hardly distinguishable from one another." This is no doubt true, and it follows that if, as no one doubts, the lion and tiger belong to separate species, there is no objection to the human "races," whose differences also concern mainly epidermal characters, being accorded the same biological rank.

Relative degree of morphological differentiation has always been, and will doubtless remain, the chief basis for discrimination of species, genera and other categories of taxonomy, in mankind as in animals and plants. The efforts of Dobzhansky ('44) to make intersterility the sole criterion of species are doomed to failure. The adoption of such an absolute criterion would reduce the taxonomy of animals and plants to chaos. This subject has been discussed at some length in my forthcoming book. Weidenreich says (p. 415), "Gates believes that the span of time a group has needed to differentiate and the duration of its isolation, *but not the degree of their morphological differences,*[1] are the criteria decisive for their ranging in certain categories." This is entirely contrary to my views, and is only arrived at by quoting one sentence out of its context. I regard isolation in some form as a necessary factor in specific differentiation, but morphological difference as the best, though by no means a perfect, measure of such differentiation.

Weidenreich's attempt to distinguish different categories of characters need not concern us here, except as regards his statement (p. 427) that morphologists have a great advantage over geneticists, "whose methods do not permit them to distinguish forms, recent or fossil, with the same degree of certitude." There are no keener observers of differences than geneticists, and surely they are not incapable of using morphological conceptions where these apply. In fact they are doing so constantly.

In his efforts to minimize race still further, Weidenreich (p. 429) states that "it is obvious that very little is known of the real nature of the racial characters of modern man.'' This subject has been dealt with at some length in the last chapter and several other chapters of my *Human Genetics* ('46). It is difficult to see that the ''real nature'' of racial characters is any more recondite than that of other human differences, except that they are more ancient and naturally more complicated and more difficult to analyze genetically than the single-mutational differences which arise in modern man. But there is no reason to suppose that the racial differences are not also mutational in origin. When Weidenreich says further, ''the furtherance (of the study of racial characters) by genetics was more an elucidation of the technic of the heredity of existing racial characters than an explanation of their development and relations,'' he seems to draw a contrast between the contributions which genetics and morphology can make to phylogeny. It appears to me that the methods and conceptions of these 2 disciplines must be closely interwoven in any further analysis of the living racial types or species.

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[1] Italics mine.

Finally, a brief reference may be permitted to one other point. In the past, anthropologists have been prone to make the widest comparisons between members of all the living human ''races,'' as though they had all sprung simultaneously from a single ancestral stock. If anything is now clear about human evolution it is that specialized or primitive races, such as the Bushman and Australians, have developed independently from different ancestral stocks on different continents. When a skull of Australoid type has been found, for instance, in South America, it has often been concluded that the Australian race, or descendants from them, reached South America. The principle of parallel variations or parallel evolution, though widely accepted by paleontologists, has scarcely been recognized at all in its application to human paleontology. The application of this principle to man removes many of the difficulties which Weidenreich finds so formidable in the interpretation of human phylogenies. He seems to be in a minority of one (Weidenreich, '46a), in regarding the *Gigantopithecus* molars as representing a gigantic human ancestor, other anatomists and paleontologists considering it a gigantic orang utan or some other giant anthropoid. The principle of parallelism alone would render it practically impossible to derive man from a gigantic ancestor.

It may be left to readers of *Human Ancestry*, when it appears, to decide how successfully modern genetical and morphological conceptions can be applied to human phylogeny, and what kinds of criteria are most usefully applicable to the problem of species in living and fossil man.

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Gates, R. R. 1944 Phylogeny and classification of hominids and anthropoids. Amer. J. Phys. Anthropology, *n.s.* 2: 279–292.

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Weidenreich, Franz 1946a Apes, Giants and Man. University of Chicago Press. Amer. J. Phys. Anthropology, *n.s.* 4: 413–431.

———— 1946b Generic, specific and subspecific characters in human evolution. Amer. J. Phys. Anthropology, *n.s.* *4:* 413–431.

R. Ruggles Gates,
Biological Laboratories
Harvard University

* * *

Captured German Anthropometric Records.— The Division of Physical Anthropology, U. S. National Museum, recently received a large body of unpublished anthropometric and other data collected by German anthropologists in Poland during 1942–43, together with some of the measuring instruments. This material belonged to the Institut für Deutsche Ostarbeit, then came into the hands of the U. S. Surgeon General's Office and reached the National Museum as a permanent loan. Full measurements and observations, photographs (5 views), personal, medical and family histories of each subject are included. Hair samples, fingerprints, and head and nose contour tracings of many of these subjects are available. Measurements and indices of the adults of most of the following series were seriated and statistical constants calculated by the Institut:

1. Ukrainians — mostly born in Kohaneza. Adults: 209 males, 147 females.
2. Poles —
    From Golkowice. Adults: 58 males, 49 females.
    From Hanczowa. Adults: 111 males, 129 females.
    From Wawrzenczyce. Adults: 198 males, 178 females.
    From Borowa. Adults: 162 males, 160 females.
    From Podhalaner. Adults: 33 males, 32 females.
    From Krakau. Adults: 209 males, 147 females.
3. Huzuls (Polish Ruthenians) — mostly born in Bukovina, Zakopane, Koscielisko, Poronin. Total: 162.

PROCEEDINGS OF THE SIXTEENTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF PHYSICAL ANTHROPOLOGISTS

The sixteenth annual meeting of the American Association of Physical Anthropologists was held on December 27, 28 and 29, 1946, at the Palmer House Hotel, Chicago, Illinois. The meeting was held in conjunction with the American Anthropological Association. President Krogman presided.

The Treasurer's report for 1946, as follows, was accepted.

TREASURER'S REPORT

Bank balance, December 31, 1945		$1,310.28
Receipts		
Dues	$825.47	
Interest, savings account	14.78	
Interest, Prudence Bond	5.38	
Disbursement, Prudence Bond	150.00	995.63
		$2,305.91
Expenditures		
To Wistar Institute for subscriptions to Am. J. Phys. Anthrop.	$559.50	
To Wistar Institute for reprints of proceedings of 15th Annual Meeting	28.95	
To T. D. Stewart, Viking Fund Grant for his administration	450.00	
To W. M. Krogman, to cover cost of 2 PA Newsletters	99.53	
Secretarial expenses	67.25	
To W. M. Cobb for expenses of 1946 election	11.35	
To W. M. Krogman for expenses of letter about instruments	10.04	
To Inter-American Society	3.00	$1,229.62
Bank balance, December 18, 1946		$1,076.29

Endowment Fund

Prudence Bond, approximate value	$ 150.00
U. S. Savings Bonds, maturity value	3,000.00
	$3,150.00

Respectfully submitted,
S. L. Washburn,
Treasurer

Audited and approved:
Gordon T. Bowles
Joseph B. Birdsell
December 28, 1946

Dr. Trotter, reporting for the nominating committee (T. D. McCown, Mildred Trotter and Harold Cummins, chairman), offered the following nominations:

For President	Wilton M. Krogman
For Secretary-Treasurer	Gabriel W. Lasker
For Executive Committee	Carleton S. Coon
For Associate Editor	Joseph B. Birdsell

All were unanimously elected.

The following were elected to membership in the Association:

Domingo Ampil
Berry Campbell
Nancy D. Campbell
W. T. Dempster
R. W. Ehrich
J. W. Griffin
C. W. Goff
H. R. Hunt
Ernest Lachman
William Laughlin
G. H. Paff
M. S. Şenyürek
Howard Strange
Frederick Thieme

The Association appropriated $150 to cover secretarial expenses in 1947. The Secretary was empowered to spend not over $50 of this amount to cover his travelling expenses to the Annual Meeting of the Association. The Association voted $50 to continue publication of Dr. Krogman's PA Newsletter. The Association also voted $100 to aid Dr. Newman in his drive to get more libraries to subscribe to the American Journal of Physical Anthropology.

Dr. Washburn reported that the Viking Fund, Inc., had appropriated funds to make a second Physical Anthropology Summer Seminar possible, and that Dr. Lasker would edit the Yearbook of Physical Anthropology again. It was also announced that the Viking Fund had started a microfilm library and was ready to film tables, illustrations, theses, or other materials which would be of aid to physical anthropologists. The Secretary was instructed to write a letter of thanks to the Board of Directors of The Viking Fund expressing the Association's gratitude for the numerous projects in physical anthropology which the Fund had sponsored.

Dr. Mettler had called the Secretary's attention to the fact that action with regard to a National Science Foundation might be required before the next meeting of the Association. President Krogman was empowered to speak for the Association should such occasion arise.

It was unanimously voted that the Association should start a monograph series, that the first monograph should consist of the papers presented in the Symposium on Early Man,[1] that Dr. Howells should edit the first monograph, and that the Secretary should ask the Viking Fund for aid in financing it.

In his report the Editor summarized the contents of volume 4 for 1946. He called attention especially to the fact that this year, for the first time, authors of articles with excessive illustrations and tabular matter were relieved of all or part of the burden of the extra printing cost. This was made possible by a grant of $450 from the Viking Fund, received at the beginning of the year. The authors so aided up to the time of the meeting were the following:

Author	*Date of publication*	*Amount*
H. Field	pp. 122–123	$14.58
Fernand Van de Ginste	pp. 125–151	30.00
A. Lipschutz, et al.	pp. 301–321	43.50
Wm. M. Shanklin	pp. 323–375	50.00
Alice Brues	pp. 463–481	34.00
N. Bayley and L. Bayer	pp. 433–461	10.00
H. Strandskov and G. J. Siemens	pp. 491–501	16.00
K. Chouke	1947	7.00
E. L. Reynolds	1947	50.00
L. Thurstone	1947	20.00
	Total	$275.08
	Balance	$174.92

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[1] Presented under the sponsorship of The Viking Fund at a joint session on December 28th.

The Editor pointed out also that since this fund was received after the March number was arranged for, it is being extended to cover the papers scheduled for the first number of volume 5, 1947.

Dr. McCown moved that the Association thank the Editor and that the report be accepted. The motion was passed unanimously.

Dr. Straus moved that the Editor be empowered to select the Associate Editors. The motion was passed unanimously.

Since the present Editor's term expires at the end of 1948, the Executive Committee was instructed to explore the question of finding a new Editor and to report at the next annual meeting. The Executive Committee was empowered to appoint a Liaison Officer to the American Anthropological Association.

Dr. Weidenreich reported on the work of the Committee on International Cooperation in Anthropology. He said that the Committee had been able to do little because of lack of funds and asked that someone else be chosen to carry on this work. Dr. Bowles was elected to represent the Association.

President Krogman, acting on behalf of the Association, awarded the Viking Fund Prize and Medal for 1946 to Dr. Franz Weidenreich.

The Resolutions Committee (T. D. McCown, M. Steggerda) introduced the following resolutions:

Be it resolved that the Association expresses its warm appreciation to Mr. Richard M. Snodgrass for his efficient and successful efforts in arranging the accommodations and facilities for the Annual Meeting held in December, 1946.

Be it resolved that the Association expresses its deep and genuine appreciation of the unremitting and successful labors of its retiring secretary, Dr. Sherwood L Washburn, noting particularly that it was during his tenure of office that important constitutional changes were effected concerning life memberships and that despite the war years the Association has grown in membership and influence as a consequence of his efforts on its behalf.

Be it resolved that the Association expresses its deep satisfaction and thanks to the Viking Fund, Inc., and to the Fund's Director of Research, Dr. Paul Fejos, for the substantial aid and encouragement to the science of physical anthropology given by the Fund during the previous year.

These resolutions were unanimously adopted and the meeting adjourned.

The titles and abstracts of papers read at the scientific sessions follow.[2]

1. The use of the stress-coat method in studying the femur. F. Gaynor Evans and H. R. Lissner, Departments of Anatomy and Engineering Mechanics, Wayne University. (Read by title.)

Although the femur is the most thoroughly studied of human bones, the "stress-coat" method provides a new and dynamic approach to the manifold problems of the architecture and mechanics of the skeleton. "Stress-coat" is the trade name for a brittle lacquer used by industry in testing parts of machinery, etc., for points of weakness and failure. The lacquer, under known conditions of humidity and temperature, is sprayed on an object and will crack from tension deformations occurring in the object. The place and sequence of appearance of the cracks indicate the points of weakness in the object and where failure will first occur.

Several adult femora of Negroes and Whites, of both sexes and different ages, were stress-coated and then placed in a testing machine where they were subjected to compression forces of known magnitude. The deformation pattern in the femur, as indicated by the place, direction, and sequence of appearance of the cracks in the lacquer, was studied with respect to the magnitude of the force and the position of the bone. The stages in applying the lacquer and the deformation patterns were exhibited.

2. Anthropometric instruments. Morris Steggerda, Hartford Seminary Foundation, Hartford, Connecticut.

A sliding and spreading caliper were demonstrated and offered for sale. In size and weight these instruments approximate our standard tools. The metal and chromium used, however, are of a cheaper quality. The degree of accuracy in the use of these tools when compared with those from Zurich or Cleveland is the same. These are made by the Swann Tool and Machine Company, Hartford, Connecticut. The price of each caliper is $7.50 and may be secured from Morris Steggerda at the above address. It is suggested that persons ordering one or more calipers, add $1.00 to each order to cover handling and mailing.

3. Cranial changes in hybrid dogs. J. Lawrence Angel, Daniel Baugh Institute of Anatomy of the Jefferson Medical College.

A preliminary experiment to reconstruct unknown parents by dichotomy of offspring uses 65 Wistar Institute hybrids. Contrasting linear, straight-muzzled and lateral, concave-muzzled main filial subgroups each show high-skulled versus small, low-skulled tendencies. Parents fail to coincide with linear and lateral subgroups. From 5 Great Dane and 10 St. Bernard skulls available the former are low, almost straight-muzzled and the latter are very large and high and concave-muzzled. Differences between these breeds fit those between the reconstructions in half the traits but show crossed resemblances in one-third of traits.

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[2] The papers are not listed in the order of presentation and do not include those constituting the Symposium on Early Man. The latter will be published in full at an early date, inaugurating the Association's Monograph Series.

Twelve F_1 skulls tend toward a lateral Great Dane. Fifty-three F_2s and F_3s show clearer segregation with linear recombinations which outdo parental reconstitutions. Such factors as selection, recombination of recessive genes (plus dominant lethals?), and diet determine this shift (partly through skull base change). Yet specific resemblances to parents clearly provide in the offspring materials for changed cranial patterns. This disproves the unlikely hypothesis of intrinsic stability of type (apart from strong selection) and leaves trait combinations as keys to analysis of connections between human breeding groups. But the descriptive usefulness of the type concept is also emphasized.

4. *The skull of the Louisiana muskrat in advanced age.* Harley N. Gould, Newcomb College of Tulane University.

This report presents data assembled as the first in a series of studies on growth changes in the skull between early maturity and extreme old age, in a single species with a continuous geographical range. The 357 specimens used were selected, from a collection of over 2000 of known sex, to represent the state of advanced age and presumably completed growth. Wear and rooting of the molar teeth are the criteria employed in selecting aged skulls. Inter-relationships of 10 different skull measurements are considered. Individual, sexual and geographic variations are reported.

A geographic cline of increasing body and skull size extends from eastern toward western Louisiana marshes. A slight but constant sex difference is found in averages of nearly all skull measurements.

Expressed as percentages of total skull length: relative condylo-alveolar length and diastema length remain practically constant with increasing skull length; while relative alveolar length, zygomatic and post-zygomatic widths, occipital height, interorbital width, and length of brain case decrease slightly. The zygomatic width relative to cranial (post-zygomatic) width increases very slightly with increasing cranial width. No sharp discontinuities in skull proportions are found anywhere.

5. *Racial patterns in vertebral osteoarthritis.* T. D. Stewart, U. S. National Museum.

The distribution of arthritic lipping throughout the vertebral column has been recorded for 3 racial groups: Eskimos, Pueblo Indians and Whites. Combining the 2 sexes and all adults above 40 years of age, the series comprise 177 Eskimos, 83 Pueblos and 104 Whites.

Lipping occurs along the edges of the bodies of the vertebrae and the edges of the articular facets. The facets in addition may show roughening or eburnation of the joint surfaces. Lipping of the vertebral bodies has been graded on a scale of 4 and according to upper and lower borders.

Analysis shows an expected general pattern consisting of increasing amounts of lipping from above downward in each of the 3 regions, cervical, thoracic and lumbar. Also, in general, the maximum amount of lipping does not occur on the last vertebra of a region (that is, C 7, T 12 and L 5), and hence these vertebrae are transitional in character, having more lipping on the upper borders than on the lower. In addition, involvement of the surfaces of the articular facets seems to bear little relation to the lipping on the bodies.

Comparison of the 3 racial groups reveals variations in amounts of lipping and facet involvement in the 3 parts of the column. The Eskimos have comparatively little lipping anywhere but in the lumbar region. However, they have many involved facets, especially in the mid-cervical and lower thoracic regions.

The Pueblos have a little more lipping in each region but have few facets involved and these are mainly in the upper thoracic region.

The Whites, on the other hand, have maximum lipping in the lower cervical region, with the lumbar and lower thoracic regions following in order. In this group facet involvement is minor in amount, occurring mainly in the mid-cervical and upper thoracic regions.

These racial variations in the pattern of arthritis may largely reflect cultural differences. However, there are certain racial variations in the structure of the vertebral column and these seem to determine the mobility of the respective joints. That this is an important factor is suggested by the striking parallel between the patterns of mobility and lipping.

6. *Increase in length of life in ancient Greece.* J. Lawrence Angel, Daniel Baugh Institute of Anatomy of the Jefferson Medical College.

Concern over social problems of a rising percentage of old people in our own society (following modern increase in longevity and recent decreasing birthrate) demands inquiry into any parallel. Three hundred and eighty-four ancient Greek adult skulls show a significant gain in age at death from 32 to 38 years between third millennium B.C. and Classic times. This paralleled improvement in living conditions, diet, health, and body size, added creative years to the span of middle age, and was a positive factor in Greek culture growth.

Soil conditions eliminate delicate skulls (aged and children). Life expectancy curves from skulls and cemeteries would show greater prehistoric-historic life span rise and higher historic period life expectancy if allowance were made for prehistoric infant deaths and for the aged (Richardson's grave inscriptions show a much higher expectancy than do skulls). Yet since life expectancy scarcely exceeded a medieval level the surviving aged were stringently selected and hardly produced modern problems of physiological (as opposed to cultural) aging. Late Hellenistic low birthrates raised the proportion of aged. But these old people added nothing to the complex socio-economic dilemma of the period because the status of old age brought definite obligations in contrast to the modern inactive role of the aged.

7. New data on racial stratification in Australasia. Joseph B. Birdsell, Guggenheim Fellow, Peabody Museum, Harvard University.

In this paper Australasia is defined to include Australia, New Guinea and Melanesia. Field work in Australia indicates that continent has been peopled by 3 major racial groups. The earliest of these were the Oceanic Negritos; the second immigrants were the Murrayian race, a primitive basic white group allied to the Ainu of Hokkaido; the last invaders of Australia were the tall, dark skinned, wavy haired and linear Carpentarians who show affinities with the aboriginal stratum of the Indian population.

Dating criteria must be used but tentatively in this little worked area. Following De Terra's terminology for the Asiatic glacial succession, the Negritos must be placed in an early fourth glacial dating. The Murrayians, as represented by the Wadjak, Aitape and Keilor remains may be given a late fourth glacial dating. The Carpentarians appear to have arrived in early post-Pleistocene times.

These same 3 basic racial groups can be traced through New Guinea and Melanesia. Populations in these areas are complicated mixtures, but it is clear that here the Negritic element is generally preponderate genetically. The Murrayian element shows clearly only in refuge areas, and there it is much mixed with the Negritic. The Carpentarian element reveals its relatively late arrival in its pattern of distribution. A fourth element, the mixed Mongoloid carriers of the Malayo-Polynesian languages, represent a late superficial gloss over the more easily accessible regions, and can be considered to have introduced the neolithic agricultural economy to this area within the last 4 or 5 thousand years.

Racially it is no longer meaningful to describe populations in this area as being Negroid, Australoid, Papuan or Melanesian. No full-sized Negroid element is present in Australasia. Australoid should no longer be used in a non-discriminatory sense to cover both Murrayian and Carpentarian elements. Papuan populations represent complicated mixtures which are racially at least dihybrid and more usually trihybrid in origin. Melanesian populations may or may not carry a significant proportion of Mongoloid genetic elements.

This conceptual scheme of racial stratification in Australasia presents far reaching implications historically for the cultural anthropologist.

8. Notes on the craniology of the Indians of the Northwest Pacific coast. Georg K. Neumann, Indiana University.

A reexamination of several series of crania of Northwest Coast Indians revealed a number of interesting new relationships. Thus a small series of putative Athapaskan crania from the Yukon Valley are practically identical with skulls of the Margid variety found in early horizons of the southeastern states, Basket-Maker II crania, and those of Indians of southern California and northwestern Mexico. A second element, already noted by Dixon as an early substratum, is found in mixture among the Haida, the Salish along the coast, and Kwakiutl. It is dolichocranial and closely related to the people of the Frazer River shell heaps, the Kootenay, and Eastern Woodland Sylvids. The third element, representing the most recent intrusion, both along the coast and from the interior, consists mainly of people of the Pacifid variety. It contributed to most present tribal groups and became highly mixed with earlier elements along the coast. Relatively unmixed remnants persisted as inland Athapaskans, a number of Salish-speaking tribes, and the Apache.

9. Notes on Indian Knoll skeletons. Charles E. Snow, Department of Anthropology, University of Kentucky.

An Archaic site on the Green River, Ohio County, West Central Kentucky, known as Indian Knoll, has yielded over a thousand aboriginal skeletons, the earliest known human remains in the state. The remarkable preservation of these skeletons provides very adequate statistical series, numbering 503 measurable adult skeletons, with 475 measurable skulls. Typical male and female adult skeletons, mounted by Ward's Natural Science Establishment, provide an unusual opportunity to observe body size and build. The average skeleton is small medium in size, is rather light but well muscled. Stature estimates for 214 ♀ are 156.9 cm; for 289 ♂, 165.6 cm.

The average cranial type of both sexes is moderate in size, has low mesocrany (252 ♂ = 75.8; 207 ♀ = 76.3) a high vault, a fairly broad face with a wide flaring lower jaw. Various examples occurring in the skulls of all age groups indicate the possible use of some kind of bifrontal head binding. The low S.D.'s compared with those listed for various American Indian groups is taken to indicate a homogeneous, probably inbred population. A monograph describing these skeletons is in preparation and will include the data for each skull listing 45 measurements and 24 indices, and will appear as Bulletin No. 3, part II, vol. IV of the Reports in Anthropology, University of Kentucky.

Part I, by Wm. S. Webb describing the archaeological setting of this remarkable riparian shell heap site, characterized by a preponderance of bone and antler artifacts and the presence of the atlatl, has recently been published (August, 1946). This non-pottery site was partially excavated and first described by C. B. Moore in 1915 and until recently was unique. Indian Knoll can now be regarded as the type shell heap site of the Southeast.

10. The cultural significance of lambdoid deformity in Mexico. T. D. Stewart, U. S. National Museum.

The term ''lambdoid'' has been used to designate an area of artificial flattening located high up on the back of the head and forming a plane inclined to the vertical. Sometimes it is combined with frontal and vertical occipital flattening. Within the United States the occurrence of this type of deformity has been reported from (1) the Chaco region of the Southwest, (2) the region occupied in historic times by the Cherokee, and (3) from one shell mound in southern Florida (Stewart, 1937, 1939, 1941).

From examination of Mexican collections I have established the fact that lambdoid deformity was present at certain sites in the States of Sinaloa, Michoacan, Puebla, Veracruz, Oaxaca and Yucatan. Analyses of these sites reveal that all belong to late culture periods. It seems likely therefore that this distribution in Mexico can be accounted for through a spread of cultural influences from the Mixteca-Puebla area in late prehistoric times as postulated by Vaillant.

In view of the fact that the Chaco sites in our Southwest date from around 900–1100 A.D., the practice of lambdoid deformity is probably older there than in Mexico. On the other hand, the sites in our Southeast where lambdoid deformity occurs may well be contemporaneous with the late sites on the Mexican Gulf Coast. Although these chronological relationships suggest cultural connections between Mexico and the United States, actual proof, as in the case of so many other culture traits, is not yet forthcoming.

11. New finds of early man in Mexico. Helmut de Terra, Viking Fund.

As a result of a field season in Mexico, made possible by the Viking Fund, Inc., 2 new pre-pottery cultures can be reported. One is associated with the falling level of Upper Pleistocene lake Texcoco and documented by a small number of obsidian and bone artifacts found at a depth of 25 feet near the pyramids of Teotihuacan and near Tequixquiac. Of typologic significance are 2 gravers and a pointed bone tool found with extinct mammal remains such as *Bison antiquus*, imperial elephant, horse, camelops and others. This industry is named ''San Juan'' after the Rio San Juan where the first artifacts were found. The second industry, called ''Chalco,'' is of Postglacial age and represented by basalt artifacts, mainly plano-convex scrapers, large choppers, snubnosed scrapers and a projectile point. Association with primitive manos and metates is suggested and a small-game hunting, seed-gathering culture inferred.

Intensive geological field work in the Valley of Mexico and on the high volcanos resulted in a detailed stratigraphy for the Late Quarternary period in which 2 (Wisconsin) glaciations and 2 corresponding pluvials figure prominently. A minor advance of valley ice in Mid-Recent times (4,000 to 2,000 B.C.) appears to correspond with a Postglacial rise of lake levels. Their oscillations continued into the ''Archaic'' culture period affording a new chronologic approach. Timed on the basis of lake recession known to have occurred prior to intensive Spanish-Colonial drainage in the Valley of Mexico, the Zacatenco culture appears to comprise the first millenium B.C. rather than the period of 100–300 A.D. as Vaillant had suggested.

12. The shovel-shaped character in the teeth of the Pima Indians. A. A. Dahlberg and Oscar Mikkelsen, U. S. Public Health Service and Field Museum of Natural History.

A study of 283 Pima Indians of Arizona revealed the shovel-shaped character in 97% of the central incisors, the remaining 3% showing traces of it. Eighty-two per cent of the lateral incisors were shovel-shaped, 9% showed a trace of the heavy marginal rims, and in only one instance was the character missing. The remaining 8% were of anomalous form. None of the centrals were anomalous. The depth of the lingual sulcus (shovel) as measured from a plane of the marginal rims ranged from 0.3 mm to 2.6 mm with a mean depth of 1.2 mm in the centrals and from 0.1 mm to 1.5 mm with a mean depth of 0.73 mm in the laterals.

The finger-like projections of small ridges in the shovel sulcus arising from the gingival base on the lingual surface were present in 86% of the instances.

An interesting and hitherto undescribed observation was made in a large number of the population wherein a shovel-like depression was found on the labial surface as well as on the lingual. This might be called a double-shovel. Thus, some labial surfaces were concave, others convex. Measurement of the depth and height of the labial surface from a given plane in a sample of 29 gave a range of from — 0.2 mm to + 0.6 mm with a mean of + 0.2 mm.

Cross sections through shovel-shaped incisors reveal the heavy marginal ridges are not overgrowths of enamel, but consist of enamel of normal thickness and dentin. The same is true of the finger-like projections.

The stability in form of the central incisor as compared to the lateral as demonstrated in the shovel-shaped character and in the occurrence of anomalies adds to the evidence supporting the field concept of development.

13. The relationship between physiologic pigmentation in the oral and cutaneous tissues of the Negro. Clifton O. Dummett, Meharry Medical College, School of Dentistry.

Pigmentation of oral and cutaneous tissues is often considered an important diagnostic factor in pathologic conditions. However, pigmentation of these tissues also occurs in persons who on thorough examination show no associated pathologic changes. This is especially true of Negroes, although physiologic pigmentation is not limited to any one race. It has been reported in many Caucasians.

About 600 Negroes of varying shades of complexion were examined to find relationship of oral to cutaneous pigmentation. The gingivae, buccal mucous membranes, tongue, hard palate and lips were examined and observations were made of the type, character and region of pigmentation. The general complexion of the skin in the lower half of the face (from the tip and base of the nose to the mentum) was used as a basis of comparison with the color of the oral tissues. Because of the wide variation in skin color of Negroes, it was decided to use 4 complexion classifications and exclude those cases in which a possible conflict in color determination might occur: (1) very dark, (2) brown, (3) light brown, (4) fair.

In the cases examined, gingival tissue pigmentation was directly proportional to skin pigmentation in a large majority of cases; that is, those Negroes of very dark and brown complexions showed considerable oral pigmentation while Negroes of light brown and fair complexions showed much lessened amounts of pigmentation. However, the number of cases of very dark Negroes with no clinical evidences of pigmentation, were enough to question the unvarying constancy of association between oral and cutaneous pigmentation.

14. Occipital flattening as a racial diagnostic. J. Franklin Ewing, S. J., Peabody Museum, Harvard University.

A series of 209 male adult Maronites of Lebanon and 126 American-born Maronites yielded startling differences in averages of headform: C.I., 88.3–79.4; length, 176.8–190.5; breadth, 156.3–152.1; height (earhole technique), 131.0–130.2. Observations were even more striking, Lebanese Maronites possessing marked planoccipitaly, American Maronites exhibiting lambdoidal flattening and strong occipital protrusion. The conclusion is that the Lebanese custom of cradling the infant (tying it down, flat on its back, for a year, as do the Armenians) is the cause of the planoccipitaly, and that this is entirely absent in undeformed heads (the American series being uncradled). It is tentatively suggested that this factor influences only the posterior portion of the head.

A survey of the distribution of hyperbrachycephaly and the custom of using cradles or cradle-boards indicates that these 2 are intimately associated over a wide area, including peoples of Central Asia, the Caucasus, the Near East, the Dinaric mountains, etc. The archeological record seems to show that planoccipitaly, as a marked and predominant phenomenon, arrived in the Near East circa 500 A.D., and may well be traced to the influence of nomadic peoples from Central Asia.

The present work suggests that planoccipitaly and other hyperbrachycephaly may be traced to infant care, wherever found. Attention to this, and to the work of Walcher and follow-up by Basler, leads to the opinion that occipital flattening, as a diagnostic of the Dinaric and Armenoid races, is fallacious. Since it is the principal one, these races may cease to be isolable. This is the case among the Maronites.

Finally, considerations of the numerous differentials in the infant skull and its early treatment suggests that not only planoccipital hyperbrachycephaly, but the curvoccipital type, and even ordinary brachycephaly, may often be conditioned by infant treatment. At least, this factor deserves proper evaluation.

15. *Some doubts about the validity of the Dinaric racial classification: A preliminary report.* Robert W. Ehrich, Peabody Museum, Harvard University.

An anthropometric series of 851 subjects, almost entirely from Montenegro, was subdivided on the basis of multiple characters into 9 subgroups consisting of predominantly Dinaric, coarse Mediterranean, Alpine, and Nordic types and their various discernible blends. Seriations showed deviations from the total series in the direction of the classical definitions of the basic types.

To test the possible effects of cradleboarding and artificial deformation in producing the so-called Dinaric type, the Dinaric classification was tentatively considered as a basically Atlanto Mediterranean-Iranian Plateau group exhibiting artificial cranial deformation. All subgroups listed as containing a Dinaric element were compared with other subgroups which would then be of equivalent racial composition. The formula $\frac{d}{\sqrt{p.e.M._1^2 + p.e.M._2^2}}$ was employed, and 3 × pe was taken as the measure of statistical validity.

The tabular pattern showed consistently valid differences only in the head measurements and related indices which could be affected by artificial deformation. Other statistically valid differences were few and scattered. A similar table comparing the metric characters of subgroups classified as non-Dinaric and presumably relatively unaffected by artificial deformation showed consistently valid differences in body, head, and face.

The first table suggests that the Dinaric ''race'' is identical with the coarse Mediterranean types but shows artificial deformation. The second table supports the general validity of the subtype classifications.

16. Genes, P-genes and racial analysis. Joseph B. Birdsell, Guggenheim Fellow, Peabody Museum, Harvard University.

Races ultimately must be defined and described in terms of gene frequencies. It may be estimated that about 25 gene series will prove sufficient to differentiate all living racial groups. Of these, 4 have already been isolated by the serologists. Since the formal geneticist operates upon a theoretical plane of research and seldom has access to human populations data, it seems clear that population genetics of the type needed for racial analysis must be developed by physical anthropologists for their own use.

Reorientation of the conventional approaches to field work must be achieved if physical anthropologists are to develop genetic techniques of analysis. Once the requisite gene series have been isolated and described for use, genetic field surveys will be simple and descriptive in nature. Until all the tools are in hand, however, it will be necessary to undertake exploratory field work in which the primary purpose is the isolation and analysis of new gene series. The adult male as a sampling unit must be replaced by the biological family, and success will depend upon the use of rigorously applied geneological controls.

The analytical gap between the present observed trait frequencies and true gene frequencies should be bridged. It is proposed to close this conceptual gap with the ''putative gene series'' or the ''P-gene.'' A P-gene may be defined as a hereditary phenotypic trait whose distribution in a population can be regularized so that a genetically meaningful comparison between groups can be made quantitatively, even though the genetic relationships of the trait have not yet been analyzed. The analysis of 2 P-genes to date has shown that this approach is fruitful. In one trait a quantitative expression has been developed which covers the integrative effect of a series of implied multiple genes. In the second trait the P-gene analysis gives every promise of resulting in a true gene frequency.

The realization of this brave new world in racial anthropology can be hastened by cooperation between physical and social anthropologists. The latter are beginning to collect personalized geneologies in the normal course of their field work, and the former need populations for whom such geneological data are available. Physical anthropologists planning field work in population genetics will do well to seek the advice of their cultural confrères.

17. The biological basis of measurement. S. L. Washburn, Department of Anatomy, College of Physicians and Surgeons, Columbia University.

The method of physical anthropology consists primarily in a series of measurements, supplemented by observations. Consultation of any of the standard anthropometries shows that the measurements are defined by their end-points, scant attention being paid to what lies between. The measurements are believed to be uncorrelated and non-adaptive. Therefore, once taken, they are treated as independent entities without further reference to underlying biological factors.

Since comparative studies comprise almost all of traditional physical anthropology, each school selected a few measurements from the infinite number possible, and the technical education of a physical anthropologist consisted of learning to take the selected measurements in the approved way. Discussions of technique have consisted in trying to get people to measure in the same way. No agreement has resulted. Actually, there is no way to debate the relative merits of different methods of measurement unless there is first understanding of what is to be measured. Each measurement poses biological problems which can only be solved by understanding the anatomy upon which the measurement depends.

If physical anthropology is to progress, it must pay far greater attention to what is included in each measurement. In other words it must seek the biological basis of measurement.

18. A study in the reliability of anthropometric techniques. James A. Gavan, University of Chicago.

From May to November, 1946, Dr. F. E. Randall, working for the Army Quartermaster Corps, carried on a study for the standardization of clothing and equipment sizes. Assisting him were Dr. G. Lasker, Mr. Melvin Baer, and the author. For 5 months of this period there were in the field 6 teams, each composed of an officer and 30 enlisted men. The enlisted men had previously been taught the necessary anthropometric techniques. It was their duty to take 65 measurements on each separatee as he was being discharged from the service.

During the course of the field work the author visited 3 of the teams and was measured a total of 66 times by the men. Before the field work started he had been measured twice by Dr. Randall. It is proposed to compare these 3 teams on 15 measurements and determine their reliability.

There are 2 problems involved. First, when the 3 teams are combined are the results distributed in a normal curve as would be expected if chance errors alone were operating? In other words are the teams consistent? To answer this all the frequency columns were graphed and found to follow the normal curve except bi-iliac.

The second problem involves the comparability of the teams with each other. The standard error of the difference between 2 means was worked out. Head breadth, hand breadth, and nose length showed some significant differences and were accepted tentatively. Bi-iliac alone was rejected. Stature, sitting height, chest breadth, chest depth, head length, head height, bizygomatic, bigonial, minimum frontal, nose breadth, and hand length were consistent and comparable. They are therefore accepted.

A comparison was made of the standard deviation and the coefficient of variation with the results obtained by 21 professional physical anthropologists who measured Mrs. M. Steggerda. Each used his own technique although Dr. Steggerda reports that in bizygomatic, minimum frontal, bigonial, and nose breadth they used the same technique. It was found that in 3 of these 4 the G.I.'s had lower standard deviations and coefficients of variation than the professionals. Out of the total 15 measurements the G.I.'s were lower in 11.

The G.I.'s had trouble locating nasion and cristale, but otherwise their variation was due to different amounts of pressure applied.

19. A method of classifying anthropometric measurements and indices: Its possible usefulness in the problems of human constitution. William Washington Graves, St. Louis University School of Medicine. (Read by title.)

Before the annual meeting of this association in 1938, the author read an abstract of a paper on the foregoing subject, and since then he has applied the proposed method to a number of linear anthropometric measurements, and to the indices derived from them, with encouraging results from some of them. He will illustrate the positive and negative results derived from 6 linear measurements and 4 indices derived from them. The qualitative evaluation of the results are derived by applying the Age-Incidence Principle of Investigation ''AIPI'' (WWG), and expressed in 0, +, or —, Survival Values.

The author finds that the results derived from the proposed method in classification, and from the application of the ''Age-Incidence Principle'' in qualitatively evaluating them, give promise of increasing the usefulness of anthropometry in the complex, yet vital and enduring problems of human constitution in relation to age, sex, race, and stocks.

20. Physique and success in military flying. Albert Damon, University of Chicago.

To ascertain whether any physical traits are consistently associated with success in military flying, 3675 young American white males were measured by one observer. The subjects included college students and 3 groups of Army flyers: those beginning training, recent graduates, and successful combat pilots. The groups were compared in respect to physical data analyzed in 3 ways: (1) the classical anthropometry of Martin (based, in some series, on 6 qualitative observations; 26 body, 35 head and face, and 7 tailor's dimensions; and 12 metrical indices); (2) Seltzer's ''disproportions;'' and (3) Sheldon's ''somatotype.''

Among qualitative traits, successful combat pilots had significantly greater muscle tonus than beginning flyers, but hair color and form, skin and eye color, and vascularity showed little or no differences.

Metrically, each successive group tended to be larger, more mesomorphic and masculine, to show fewer disproportions, and to be less variable than the preceding group. The greatest differences between adjacent stages occurred between non-flyers and beginning flyers.

The most marked and consistent differences, statistically significant at each stage, was chest girth, which increased both absolutely and relative to stature and head circumference. The percentage of disproportions — based on Seltzer's Harvard standards — in the chest circumference/stature and head circumference/chest circumference indices dropped steadily, while mesomorphy — both in mean strength as a separate component and in its percentage of predominance over endo- and ectomorphy — rose progressively with success in military aviation.

21. A photographic analysis of changes in bodily form after 24 weeks of partial starvation. Gabriel W. Lasker, Department of Anatomy, Wayne University College of Medicine and Laboratory of Physiological Hygiene, University of Minnesota.

Under the supervision of Dr. Ancel Keys of the Laboratory of Physiological Hygiene at the University of Minnesota, 34 male American volunteer subjects, aged 20 to 33, were subjected to a rigorously limited diet for 24 weeks. During this period they lost an average of 16.76 kg (24% of their body weight). The staff of the laboratory took standard nude photographs of these individuals before and after the period of partial starvation and these were made available to the author for study.

Measurements taken on the photographs show, relative to stature, a significant decrease in all diameters. In most dimensions every individual showed the decline. The reduction in upper thigh depth and upper arm thickness was approximately 25%. Waist, trunk, neck and limbs also markedly decreased in thickness. In general, changes in the photographic measurements exceeded changes in measurements taken by Dr. Josef Brozek on the subjects at the time of the experiment.

When measurements were converted to ''somatotypes'' by the method described by Sheldon, marked changes in ''somatotype'' were noted. The mean change was a decrease of 1.7 units in endomorphy and mesomorphy, and an increase of 2.7 units (i.e. 80%) in ectomorphy. It is clear from the pictures that ''ectomorphy'' as a result of inanition looks different from ''habitual'' ectomorphy. However, the technique of ''somatotyping,'' as it is applied in this study, would seem to be more useful for determining the state of nutrition than for determining the inherent constitution. Furthermore, preliminary studies by Dr. James M. Andrews IV indicate that the anthroposcopic criteria are also similarly affected by partial starvation.

22. Anthropometric differences between somatotype groups. C. W. Dupertuis and W. H. Sheldon, Presbyterian Hospital, New York.

Measurements taken on standardized photographs of 6 somatotype groups were compared in order to determine whether or not the mean metrical differences were statistically significant. The somatotype groups chosen for this study were: 2–3–5, 2–4–4, 2–6–2, 3–4–4, 4–5–2 and 5–3–3. In every group to group comparison the level of statistical significance was reached. The greatest differences occurred between the more massive somatotypes on the one hand and the more linear on the other. The most similar groups, according to the measurements taken, were the 5–3–3's and 4–5–2's and the 4–5–2's and 2–6–2's. The fact was again verified that measurements taken on the body or on the photograph do not differentiate well between the first and second components.

23. The relation between staple diet and average physique in human communities. Elsa McMillan and R. Armattoe, The Lomeshie Research Centre for Anthropology and Race Biology, Londonderry. (Read by title.)

The correlation between physique and diet is familiar to physical anthropologists and school officers, but the relative stature of a community as contrasted with that of another, has not been seriously studied. For instance, we know very little about the stature and physique of the peoples of the rice-eating regions, namely, India, Ceylon, Burma, Indo-China and Manchuria. We know a little about the Japanese, but practically nothing of the West Africans, the Bantus or the Melanesians.

We deem it advisable, in the present state of our knowledge, that social anthropologists should collect material in a reliable form, concerning the staple diet (with sampling from 2 or 3 families), and also the crude average height and weight of the young men and women in the community. Folk lorists may also help by collecting the legends concerning the longevity of the community, and the origins, real or alleged, of the articles of diet of the people.

A study of this nature, coupled with an elementary economic study of the community, will be useful to epidemiologists, Public Health authorities, school officers and statesmen, as well as enabling us to suggest the most economic way of improving the health and standard of living of all communities.

24. A simple method for the demonstration of the iron pigment in human red hair. Peter Flesch and Stephen Rothman, Department of Pharmacology and Section of Dermatology, Department of Medicine, University of Chicago.

An iron containing red pigment is described which was found to occur in bright red human hair exclusively. The characteristic properties of this substance make its detection possible in 0.1 gm red hair. After a preliminary treatment with chloroform, acetone and acetic acid at room temperature, the hair is boiled with 2% hydrochloric acid for an hour. The resulting light pink color of the solution turns yellow upon alkalinization and regains its original pink shade when reacidified. The test is simple and geneticists may use it as a criterion in studies on inheritance of red hair color. (See this Journal, n.s., vol. 5, p. 109.)

25. Body hair patterns in man. Stanley M. Garn, Peabody Museum, Harvard University.

In man body hair develops rapidly at puberty and continues to increase in density through old age. The patterns are distinct in each sex even when the density is the same. Hypogastric hair differs structurally from pubic hair and its mode of growth is different. Hypogastric hair may follow the linea alba up to the navel or to the ensiform process, it may outline or cover the abdominal rectus muscle, or it may be diffusely scattered over the entire lower abdomen. The second distribution is more common in the strongly muscular "mesomorphic" type, and the last-named form is commonest when the abdomen is round and fleshy.

Most white males have hypogastric hair and hair over the lateral vastus muscles. Chest hair is highly covariant with hypogastric hair, and is rarely present when the latter is absent. Mid-digital hair appears to be associated with body hair in Whites.

American Negroids have considerable body hair, and even unmixed Africans show some body hair. The form of the body hair is usually the typical "spiral-tuft," while the White distribution patterns prevail in the mixed-bloods.

The direction of growth of the hair on the limbs is toward the digits. This finding is in opposition to some earlier studies.

26. External changes associated with sexual maturation in girls. Earle L. Reynolds, The Samuel S. Fels Research Institute, Antioch College, Yellow Springs, Ohio.

Individual differences in somatic changes associated with puberty appear to be related to comparable differences in several areas of human development. As a preliminary to the examination of such larger problems, a report of sexual maturation in girls is here presented, based on records of 50 subjects from the Fels Research Institute for the Study of Human Development.

Items considered include menarche, distribution of pubic hair, and the size, shape and maturation of breast. Scales for rating stage of maturation of breast and pubic hair are presented, and the inter-relations of these characteristics, as well as their relationship to menarche, are examined.

Individual patterns and sequences of normal and unusual sexual maturation are shown and discussed.

27. Lung lobation in a series of primates. C. F. De Garis, Department of Anatomy, University of Oklahoma School of Medicine. (Read by Alice Brues.)

Our statistical series of primate lung lobation consists of 458 rhesus, reported by Chase ('42). The other 68 primate specimens are widely varied, from tarsier to gorilla; there are many gaps, and some genera are represented by only enough specimens to sample lobation, others enough to indicate variation trends. Thus our 3 orangs are all non-lobate, whereas 8 chimpanzees have bizarre lobations, suggesting much more than the 10% variation in rhesus. Likewise 5 gibbons show much diversity, while 2 gorillas are basically alike except for differences in the cardiac lobe (in older literature erroneously called the azygos lobe). This is a minor, mesial lobe, more common on the right, but in some specimens (2 tarsiers, 2 chimpanzees) occurring on both sides. No humanoid azygos lobe, resulting from apical cleavage by the azygos vein, is found in any of our primates. Nothing precisely exemplifying human lung lobation is found in our series; the number of lobes is sometimes the same as in man, but the fissure planes are different. Nothing in our 68 specimens can be construed as an evolutionary trend, from tarsier (5 or 6 lobes) to gorilla (3 right lobes plus cardiac and 2 left lobes).

28. The cortex of Hapale. Gerhardt von Bonin and James K. Peden, Departments of Anatomy and of Neurology and Neurological Surgery, University of Illinois, College of Medicine.

The marmoset is a small platyrrhine monkey with a retina possessing a macula lutea and a hallux which cannot be opposed, and is the only digit bearing a nail instead of a claw.

The weight of the brain in relation to the body weight shows a coefficient of cerebral development of .82, as compared with .79 for the whole group of primates. The hemispheres show a calcarine, sylvian and a rudimentary parallel sulcus. The ventricle shows a well-developed posterior horn.

The cortical cytoarchitecture has been studied in a specimen which the authors owe to the kindness of Dr. John F. Fulton and Dr. Margaret Kennard. The map is in general simpler than that of larger brains. A comparison with macaque and man can be carried through. The visual sector shows a high degree of differentiation. In the central sector motor and sensory areas overlap each other. The premotor area FB is small. There is present, however, an area which appears to be the homologon of Broca's area FCBm in man. Frontal and parietal sectors are much simpler than in higher forms. The fundamental type of the cortex is, however, the same in all primates.

To be published in full in the Journal of Comparative Neurology.

29. The riddle of man's ancestry. William L. Straus, Jr., Department of Anatomy, The Johns Hopkins University.

It has not been established that man has evolved from an anthropoid ape. Indeed, his large number of paleopithecoid (monkey-like) characters, which are absent in anthropoids, indicates otherwise. Known facts strongly suggest that the line leading to man became independent of the primitive catarrhine stock before there were true anthropoids — i.e., prior to the differentiation of the gibbons. The pre-hominids at that time would have to be regarded as paleopithecoids, not anthropoids; they would be scarcely more than monkeys with expanding brains, reduced tails, and generalized extremities. In their evolution, they apparently avoided brachiating specializations and early became terrestrial bipeds, thus never passing through a true anthropoid stage.

Many of the distinctive characters of man and anthropoids are foreshadowed or even paralleled among existing Old-World monkeys. Hence the resemblances between man and anthropoids need not indicate close relationship, but can be logically explained on the basis of parallel, independent combination of genes already existing, or potentially existing through mutation, in remote common ancestors — primitive catarrhine paleopithecoids. Consequently, it may be concluded that the lines leading to all 4 existing Old-World groups — monkeys, gibbons, great apes, man — early separated from the generalized catarrhine stock and underwent their independent courses of evolution, so that they bear no particularly close relationship to each other.

This concept of human ancestry naturally cannot be regarded as even approximating finality. On current knowledge, however, it is more logical than the orthodox anthropoid-ape theory. The ultimate verdict will rest upon fossil evidence which now is lacking. The problem of man's ancestry remains in many ways a riddle.

30. The antiquity of Homo sapiens. M. F. Montagu, Department of Anatomy, Hahnemann Medical College and Hospital.

The concepts of orthogenesis and missing links have done much to retard the understanding of the manner of man's evolution. Evolution knows no straight lines, it is a labile reticulate process occurring within the varying matrices of space-time. Straight-line thinking has rendered unacceptable the evidences of such types as Piltdown, Galley Hill, Vichy, Kanam, and even Swanscombe, as being early types of sapiens men. It was held that on morphological grounds they could not belong to the horizons in which they were alleged to have been found because according to orthogenetic principles they could only be later in the scale of evolution. The fact, however, is that the existence of such a type as Swanscombe during the Second Interglacial renders it likely that early sapiens types were already in existence in the Lower Pleistocene, if not before. Furthermore, the time-space position of Swanscombe renders it likely that among the ancestors of Neanderthal man sapiens types are to be reckoned.

31. Selection and the mental characters of mankind. M. F. Ashley Montagu, Department of Anatomy, Hahnemann Medical College and Hospital.

An attempt is made to show that since the attainment of human status the behavioral quality which has been at the greatest selective premium is plasticity, and that this is the only general trait which has been actively selected in human societies. Other specific traits have undergone a secondary selection only insofar as they have been of the kind which permit themselves to be eclipsed by the phenotypic plasticity. The effect of the postulated genetic trend towards the selection of genotypes having the qualities of plasticity has been and continues to be to render genotypic differences in personality traits, as between individuals and as between groups, unimportant compared to their phenotypic plasticity. This should not be construed to mean that individual differences are decreasing. On the contrary, there is evidence that they are increasing and that at the same time the inter-group differences have been decreasing. The evidence of palaeoanthropology and of our own eyes today shows beyond any question that the trend has been for the inter-group gene differences to be reduced and for the individual genotypic differences within each group to be decreased. Fortunately for mankind, while becoming more like the trend has been toward genotypic variability, and clearly towards phenotypic plasticity.

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Vice-President	Morris Steggerda	1948
Secretary-Treasurer	G. W. Lasker	1951
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	C. W. Dupertuis	1948
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[1] Life members are listed separately on p. 249.

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STAGES IN ADOLESCENT DEVELOPMENT.— Modern research on the reproductive physiology and growth of mammals such as the mouse, rat, macaque, chimpanzee, and man, very strongly suggests that puberty, menarche, and the development or attainment of the capacity to reproduce are phenomena by no means so closely associated with one another as has hitherto been supposed, but rather that they are distinctly separable phenomena both in time and in character. It now appears fairly certain that puberty itself properly represents an extended process of development, rather than an event or a moment in time; and that it is during the progress of this developmental process that menarche is gradually established, and reproductive capacity only very rarely. Puberty does not mark a stage of development, but represents more clearly a *phase* of development. Menarche represents a stage in that particular phase of development, the stage of beginning (anovulatory) ovarian activity. The capacity for reproduction generally follows appreciably later. The attainment of this capacity marks the termination of the period of puberty and the initiation of the period of nubility which, in the human species, terminates in the period of maturity only after a lapse of some years in time, and much increase in size and differentiation of various organs.— M. F. Ashley Montagu. *Adolescent sterility.* Charles C. Thomas, Springfield, Ill., 1946, ix + 148 pp.

THE PRIMARY DENTITION IN HOMO SAPIENS AND THE SEARCH FOR PRIMITIVE FEATURES

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THREE TEXT FIGURES AND FOUR PLATES

THE INTERLOCKING CANINES

The literature of physical anthropology indicates the value attached to the possible discovery of an ancestral form, in which the canines differed from the canines as known in all species of man, and approximated the condition seen in the anthropoid apes — interlocking canines. Many authorities are convinced that this feature characterized the dentition of the primitive ancestral type of early man. So far, the only possible appearance of such a feature has been in Piltdown, and here there is, after all, no real certainty. Some scientists even consider this canine is not human. Turning our attention to the apes, and the other families of primates, we see interlocking canines of varied size and shape. In the males they are larger than in the females. In the Chimpanzee, the canines are relatively smaller than in the other apes and lower families, so that many physical anthropologists have learned to look for a remote human ancestor displaying relatively larger canines than exist today, with a diastema in the maxilla.

Keith ('25, pp. 674–675) has devoted close attention to the teeth of the primates and discusses "caninism" and its manifestations. A quotation from Tomes ('23, p. 463) in the section devoted to the teeth of ungulates has a certain amount of interest in this canine question:

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Cuvier first pointed out that there was a relation between the presence of horns and the absence of canine teeth; the latter, serving as weapons of sexual combat solely, and being probably in no other way of service to the animal, are not required by an animal provided with powerful antlers or horns, whereas the absolutely hornless musk deer would be totally unprovided with weapons of offence were it not for his canines.

Instances are given proving that deer with horns have no canines, and vice versa. There would seem then to be grounds for assuming that canine teeth are primarily weapons of offense and defense.

The writer suggests that in forming some conception as to what we may reasonably expect in the earliest human forms, we should look not so much for interlocking canines of the anthropoid type, as canines having the relative dimensions, and in particular the occlusal relationships which are so often to be seen in the primary dentition. The deciduous teeth are formed long before eruption, even before birth, and it surely is quite a likely assumption that the primary dentition displays a greater resemblance to the primitive secondary, than does the human secondary dentition of today.

Admittedly, there are dangers by which we are surrounded in assuming relationships of this nature. Gregory ('34, p. 191), in deprecating any such line as a general principle, points out that in physiological processes the course of development is fundamentally anticipatory rather than reminiscent in character, because the most pressing business of the embryo is to provide the ground plan for an adult of its own species. And yet it is a fundamental principle of evolution that the development of the human embryo discloses the many links with other forms of life.

The function of teeth, be they primary or secondary, is to masticate coarse food and prepare it for digestion. As Campbell ('25, p. 81) has pointed out, the food of the Australian aboriginal child differs in no regard from that of the adult; nor is there any reason for thinking that it should be otherwise.

We propose to assume that characters which are observable in the primary dentition are not merely attributes of the "milk" dentition — if we may use a term which is apt to convey a wrong conception of function and structure — but may record primitive characters, which have long since been lost to the secondary dentition.

Mesio-distal measurements

Turning to Keith's "New discoveries relating to the antiquity of man" ('31, p. 108), where he is discussing the dentition of Australopithecus, we find the following table of mesio-distal tooth measurements (in mm):

	MILK DENTITION					PERMANENT MOLARS		
	I^1	I^2	C	M^1	M^2	M^1	M^2	M^3
Gorilla	7.5	6.5	9.5	9.0	10.5	14.6	15.2	14.1
Orang	10.5	8.0	10.5	8.5	11.5	11.7	12.0	10.0
Australopithecus	5.2	4.5	6.5	9.2	10.0	13.0		
Chimpanzee	8.6	6.5	8.0	6.0	9.5	10.0	10.2	9.0
Man	7.1	5.0	5.3	6.8	7.5	10.7	9.2	8.5

The writer has not had the opportunity of examining the wealth of material which is available to others in well endowed institutions in city centers, and must accept the figures for the anthropoid apes. However, he has made examinations of a number of children (European) and the figures obtained do not accord with those given by Keith for man. It will be observed that in the mesio-distal diameters, that given for the second deciduous molar is slightly more than that for the central incisor, and that the lateral incisor, the canine and the first deciduous molar all have a smaller mesio-distal diameter than the central incisor.

This is not the writer's experience, and he feels that an error of some kind has crept into the figures cited. The measurements obtained by the writer accord very well with those contained in Black's "dental anatomy" (1892, pp. 10–12).

In order to estimate the extent of the diminution of the canine which seems to be apparent in man as compared with the anthropoids, the writer measured the primary dentition of a number of children of whom he was able to secure impressions, and of the secondary dentition of a number of adults. The figures were in each case dimensioned to the arbitrary figure of 100, which was allotted to the central incisor. The measurements given by Black were similarly treated. The mesio-distal measurements in millimeters for the maxillary deciduous dentition are as follows, with the proportioned figures immediately below. It is proposed in the following tables to explore relative dimensional relationships between the central incisor and the canine.

DECIDUOUS TEETH

	I^1	I^2	C	$D.M.^1$	$D.M.^2$
Jones	6.5	4.9	6.9	7.0	9.2
	100	75	106	107	141
Black	6.5	5.1	7.0	7.3	8.2
	100	78	107	112	126

PERMANENT TEETH

	I^1	I^2	C	P^1	P^2	M^1	M^2	M^3
Jones	9.0	6.9	7.8	7.3	7.0	10.4	9.8	8.8
	100	76	86	81	77	115	109	97
Black	9.0	6.4	7.6	7.2	6.8	10.7	9.2	8.6
	100	71	84	80	75	119	102	95

In the teeth under consideration Black's figures obviously give the same result as those obtained by the writer, and it is clear that relatively the deciduous canine is quite substantially larger mesio-distally than its permanent successor.

Let us examine the mesio-distal tooth diameters of the gorilla, orang, Australopithecus and chimpanzee as given by Keith, these being the only measurements of anthropoid deciduous dentition available. The same method of comparison is used as previously, that is, the mesio-distal diameter of the central incisor is dimensioned to 100.

	I^1	I^2	C	DM^1	DM^2
Gorilla	100	86	126	119	140
Orang	100	76	100	81	109
Australopithecus	100	86	125	177	192
Chimpanzee	100	75	93	69	110

It is with the canine figure only that we are concerned, and 2 features at once strike us:

1. The likeness between gorilla and Australopithecus, extending to the lateral incisor also.
2. Orang and chimpanzee are much closer to man in this comparison.

Labio-lingual measurements

If we contrast the labio-lingual measurements of the human deciduous dentition with those of the permanent dentition, using Black's figures, and the specially dimensioned form of comparison used above, we see that the deciduous canines are very different from the permanent canines.

DECIDUOUS TEETH					
	I^1	I^2	C	DM^1	DM^2
Black	5.0	4.8	7.0	8.5	10.0
	100	96	140	170	200

PERMANENT TEETH								
	I^1	I^2	C	P^1	P^2	M^1	M^2	M^3
Black	7.0	6.0	8.0	9.1	8.8	11.8	11.5	10.6
	100	85	114	130	125	168	164	151

What is the inference from this array of figures? The writer desires to show that we may look for an ape-like or pre-human ancestral being in which the canines would be relatively larger mesio-distally and labio-lingually, in comparison with the incisor teeth, than are to be seen today, and would bear a somewhat similar ratio to the permanent incisors to that the deciduous canines bear to the deciduous incisors.

In passing, the similarity between gorilla and Australopithecus already referred to may not be without some evolutionary significance.

Modes of mastication

Let us now turn to the process of mastication. At the outset, it must be pointed out that man differs from other primates in this regard. Despite the fact that in man the glenoid fossa is basically deeper than in other primates, there is more range of lateral movement in the excursions of the mandible. These latter in the human subject are complex, but are well enough known. Briefly, the mandible is thrust laterally so that the buccal cusps of the lower posterior teeth occlude with the lateral border of the buccal cusps of the maxillary teeth on that side. The temporal, masseter and internal pterygoid muscles then crush the occluding teeth together, and at the same time the mandible moves medially and slightly upward to the position of centric occlusion. On the opposite side, the teeth do not make contact until just before centric occlusion. Mastication is from lateral to medial, and is unilateral, the teeth of the opposite side being definitely not in contact. The food bolus is, by means of the tongue and teeth, kept on that side only where the shearing stresses are taking place.

There are certain fundamental differences between man and ape in the mode of function of the dental machine, which the writer does not believe have been fully made clear in current literature. In order to investigate these differences the writer made a motion picture of a rhesus monkey having a meal, and of a European with an excellent natural dentition reproducing the movements of mastication. In the case of the European the movements were recorded with the lips open and also with the lips closed. This film demonstrates quite clearly the differences in the mandibular movements of mastication between man and the other primates. With the monkey there are certainly no lateral excursions of the mandible, movement being practically straight up and down.

If there is any lateral movement, it is very slight and almost negligible. Comparison of anatomical specimens will prove that monkeys and anthropoid apes are very different from man in the movements of the masticatory machinery, and the difference can all be laid at the door of the canines. These practically prevent lateral movement of the mandible. A slight lateral movement may be attained after many years, but this is strictly limited and can only result after heavy attrition.

The photographic reproductions of the maxillary and mandibular teeth of a gorilla (plate 1 A) will indicate that the buccal cusps of the maxilla, and the lingual cusps of the mandible are not worn to any degree comparable with their fellows. The main area of occlusion is gouged out of the teeth to a very noticeable depth, and clearly proves the assertions made earlier.

A very eminent English scientist in a private letter has suggested that, with the anterior teeth edge to edge, the posterior teeth could move laterally. This, however, is impossible as can readily be demonstrated by a simple experiment. Place the anterior teeth in the position for incision; then try by manual pressure at the angle of the mandible to move it to one side. It will be found that the slightest movement is accompanied by movement in the incisor area.

Should we compare the dentition of the apes and monkeys with the dentition of the Australian aboriginal, we cannot but be forcibly impressed by the fact that under attrition, the cusps of the human teeth are completely worn away and present a flat surface. Now it is a different condition that we see in the anthropoid, in which the buccal cusp formation of the teeth tends to persist even when attrition is marked, proving that there is practically an absence of the shearing component of mastication.

The 2 photographs of a male gorilla taken from the front and side (plate 1 B) will indicate that in spite of the pronounced attrition which is manifest in the anterior teeth, the posterior teeth still retain their cusp formation.

This difference between man and the other primates is of supreme importance, being fundamental. Since the cusp formation, which exists at tooth eruption, tends to persist much longer under attrition in the anthropoid, we should be justified in assuming that the mode of mastication and the mandibular movements seen in them are the more primitive. Man alone of the primates, has learned to incorporate the shearing stress into his masticatory apparatus. The result is that in the primitive state, living on rough fare, he suffers rapid occlusal attrition, the cusps being shorn completely away quite early in adult life. To put it another way, man has tended to adopt in this regard the mode of mastication of the ruminants, without possessing any form of compensatory mechanism, such as nature has provided them with, to meet this factor. The attritional wear seen in such fossil types as Rhodesian man, Neanderthal man and Sinanthropus is exactly such as we have described for modern man.

The vertical masticatory movement of the mandible in apes, caused primarily as we have seen by the large canines, has a particular effect on them. Attritional wear tends to keep them sharp. The lower canine is accommodated between the distal of the lower canine and the mesial slope of the first lower premolar, but not so much into a diastema as into the "V" shaped space formed by these 2 teeth, at the same time overlapping them to some degree.

Let us now examine the canines of the temporary dentition in order to see if any vestige of a similar condition can be seen. The models depicted in plate 1 C–D are from a child of known British extraction, my own daughter when 4 years old, and the mouth has been under constant supervision since the eruption of the earliest teeth. The features therein described are not universal, but are quite common, and the writer has observed a considerable number of similar cases.

Photographic reproduction of the features to be indicated has not proved easy, but the mandibular cast shows the areas (white) where the maxillary teeth occlude with the lower teeth. The models were held in occlusion and the right mandibular teeth below the line of occlusion were heavily pencilled.

Examination of the models discloses a noteworthy feature. It will be observed that in central occlusion, the distal slope of the lower canine makes contact with the mesial slope of the upper canine and that this tends to keep the canine tips sharp. This, the writer believes to be a most important survival of a primitive condition, and is a somewhat similar condition fundamentally to that shown in the canines of the gorilla (plate 1 A). This is the means adopted by nature to keep the canines — a weapon of offense — in a proper condition. The canines obviously are relatively large mesiodistally; they project beyond their incisor companions, and to a slighter extent beyond the occlusal surfaces of the molars. Examining the models and testing the lateral movement of the lower indicates that the upper canine has a decided interlocking action. Even from the photographs this is evident in the unpencilled portion of the lower cast, this being the area occupied by the maxillary teeth in centric occlusion.

THE EDGE-TO-EDGE BITE

Should it be pointed out that the edge-to-edge bite does not exist in the models, and that on that score the claim for primitive features in the canines must be queried, the writer would reply that he is not at all convinced that the edge-to-edge bite, as seen in Australians and other primitive types of man, is necessarily a primitive feature.

Campbell ('25, p. 51–52) has proved that the human edge-to-edge bite is not manifest during the eruption of the permanent teeth, and he supports his argument by means of photographs of 4 separate stages. Plate 2 A depicts 2 views of the skull of an aboriginal child, facial and profile. In these, the maxillary incisor teeth most definitely overlap the mandibular incisors.

Campbell asserts that

> The specimens [shown in his illustrations] are quite representative of the age groups from which they have been selected, and are sufficient to demonstrate the assertion that the "edge to edge" bite, said to be typical of the Australian dentition, was one which, though present in the adult almost without exception, was a modification only acquired by the attaining of adult age (p. 52).

In searching for the cause of the aboriginal edge-to-edge bite, Campbell observes:

> In any series of Australian skulls which includes sufficient specimens of varying ages, it can be seen that the presence of the edge to edge [bite] is associated with the occlusal wear the teeth have undergone; that is, a diminution in the cusp height of molars and premolars is accompanied by an apparent shifting forward of the lower anterior teeth relative to the upper anterior (p. 51).

The practice of prosthetic dentistry will disclose the underlying truth of Campbell's contentions. Any prosthetist knows that in the construction of full upper and lower dentures, "closing the bite" after setting up the teeth demands that the lower anteriors be set up in a more posterior position, or that the upper anteriors be moved forward. The converse requirements of "opening the bite" disclose the conception better, as, if the bite be opened, it will be readily observed that the lower anteriors appear to have moved backward as well as downward, in relation to the upper anteriors. In our professional duties we frequently observe that clients who have been wearing the same artificial dentures for many years have experienced much alveolar resorption, and that the lower anterior teeth which once were set within the upper anterior teeth, have come to occupy a position in front of the upper incisors. This would seem to bear out Campbell's contentions.

Campbell, however, does not feel that this is a complete explanation of the feature. His research has indicated to him that although occlusal wear has apparently brought the lower anterior teeth forward, the lower molar teeth still occupy the same relative position with regard to the maxillary molars. "Therefore," he says, "it seems as if we must consider the main change as having occurred in the anterior region of the arches. It seems that the condition must be brought about by some change in the relative positions of the anterior teeth in the 2 arches" (p. 52). His later research indicates that a probable factor is "a widening of the arch in the canine-premolar region" (p. 52).

The writer suggests a factor which seems to him to be fundamentally connected with the acquisition of the edge-to-edge bite, and is possibly a complete explanation of every phase of this characteristic. Primitive man needed powerful incision for the dismemberment of tough food, in particular, meat, which played so large a part in the aboriginal diet. Meat held firmly in the incisor teeth was dragged forward by hand and in this manner divided. Against the force forward and slightly downward imparted by the hand, a corresponding force backward must be applied by the mandible; so that the anterior teeth of the mandible would tend to move slightly forward as a result of this applied force.

Now "depression" is a regular part of the repertoire of the orthodontist, and teeth may be depressed as desired, where it is considered advisable to move a tooth into its alveolus to some extent from its original position. The surrounding bony structure, the periosteal attachment, or peridental membrane, and the gingival tissues accommodate themselves to the new position quite normally; so that in any primitive state where continual use of the incisor teeth is a regular feature, the writer feels that the combination of forces described leads to the lower anterior teeth being drawn slightly forward, and at the same time depressed until the posterior teeth come into occlusion together with the anteriors. The dental machine in the primitive state is then complete.

In plate 2 B, C, D and E are reproduced a number of photographs of aboriginal crania which should prove the statements made.

In plate 2 C there is an overbite of the upper anterior teeth, and the upward curve of the mandibular bony margin at the necks of the teeth is apparent.

In plate 2 D an intermediate state is apparent. The bite is edge-to-edge, but the lower left lateral incisor and the lower right central incisor are placed more lingually than their companions, owing to slight crowding. If the gingival enamel margin be observed, it will be apparent that the lower canines, left central and right lateral incisor have been depressed and contrast sharply with the left lateral and right central incisor.

In plate 2 B the upper central incisors have been removed. It will be clear that the occlusal contour of the lower incisors is not all due to lack of attrition. The mandibular bony contour at the necks of the teeth shows an upward convexity nearly as great, the difference in the convexities being merely due to lack of attrition.

The illustrations in plate 2 E of an unusual case are of great interest. First, the relationship between the maxillary and mandibular arcades is uncommon. In spite of the anterior relationship, the posterior teeth have been ground to a cuspless functional plane. Secondly, the mandibular gingival enamel line from canine to canine shows a sharp upward convexity, as indeed our theory would lead us to expect. Thirdly, the bony resorption seen on the anterior aspect of the roots of the lower central incisors is quite marked. The reason is apparent in the profile view and is obviously the forward pressure exerted by the upper centrals on the sloping lingual of the lower incisor teeth.

Examination of the profile and facial views of the aboriginal child represented in plate 2 A will indicate that malposed teeth are not confined to European teeth. Nevertheless, there can be no doubt that in this case powerful incision increasing with maturity would have forced the anterior teeth into 2 uniform dental arches by the time adolescence had arrived.

The writer claims that the resemblance between the edge-to-edge bite of man and that of the anthropoid apes is more apparent than real. In anthropoid apes and catarrhine monkeys movement is practically up and down, so that the anterior teeth must occlude in the same mandibular position, as otherwise incision would be impossible.

The same feature is to be seen in the primary dentition of the apes (plates 2 F, 3 A), the bite being of the same edge-to-edge type that is evident in their secondary dentition. The canines are interlocking, but not on the same scale as in the permanent dentition. In the baby chimpanzee the bite is absolutely edge-to-edge; in the orang, although the upper central incisors overlap the lowers ever so little, the bite is to all intents and purposes edge-to-edge.

The edge-to-edge relationship in the adult Australian aboriginal is really of a somewhat different order from that of the other primates. First, there is not entire uniformity in the relationship of the lower anteriors to the uppers; in some, the uppers are to a slight extent anterior to the lowers; in others the anterior surface of the crowns of the uppers is continuous with those of the lowers. The bite is edge-to-edge, with a few exceptions; but in some it is only just edge-to-edge, while others occupy various positions between this stage and the absolutely edge-to-edge relationship. These findings were observed and described by Sir William Turner (1891, p. 461), and need no illustration. Secondly, in the Australian, the canines reduced in size, perhaps as a result of Keith's "evolutionary bias" ('25, p. 456) are relegated in function to the position of incisor teeth, and owing to this a heavy shearing stress can be obtained by moving the incisor teeth laterally.

The writer has already claimed that the Australian edge-to-edge bite is the result of tearing tough and coarse foods, meat in particular, by means of the anterior teeth. If this were not so, we should expect aboriginals born in the Mission Stations to have an edge-to-edge bite, as an inherited trait, in spite of a European diet. This is most definitely not the case. The writer has examined a number of aboriginals in Mission Stations, and the relationships of the anterior maxillary and mandibular teeth are exactly as in our British race in this continent. There is not a trace of edge-to-edge bite, and the overbite can be very pronounced.

Examination of the very few pure aboriginal children in the Mission Stations, all of these being about 10 years old, discloses the truth of Campbell's findings with regard to the overbite relationship. There is not the slightest trace of any condition different from that seen in our British children.

Surely no further proof is required that the Australian aboriginal in the relationship of his anterior teeth, differs in no material regard from the European. Quite obviously he inherits no edge-to-edge bite as do the other primates. The writer believes that if a European child could be reared under primitive conditions with Australian aboriginals completely remote from European influence, he would develop in the anterior teeth the same edge-to-edge bite.

THE DIASTEMA

Linked with the search for human interlocking canines is the expectation of finding a fossil human dental arcade with maxillary diastemata to accommodate the mandibular canines. The literature pertaining to the teeth of fossil man indicates the general expectation that some such condition is considered to belong to the ancestral human form at some remote period. Not yet have the expectations been realized.[1] If the edifice of Smith Woodward and Keith be correct, Piltdown Man in all probability had maxillary diastemata, but this is after all only assumption, in the light of our present knowledge.

Weidenreich ('37, p. 138) makes reference to the general search for the diastema in his discussion of the features of the Sinanthropus dentition as follows:

> In the chapter dealing with the canine problem, the question had already been raised whether the presence of a diastema can be taken to be an indication of there having existed

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[1] The writer is not aware that diastemata are present in Pithecanthropus robustus. Neither does he know of the discussion of this subject by Montagu and Weidenreich (this Journal, n.s. *4:* 193–201). For further explanation see p. 23 — Ed.

> originally a large canine in a preceding stage of human evolution. Within this chapter it was shown that a diastema had not been present in the lower dentition of Sinanthropus, but what the conditions were in the upper jaw could not be ascertained, due to lack of material. Since the writing of that statement the upper jaw of Locus O I was found, which demonstrates that there is not the slightest indication of the presence of a diastema. Nevertheless, as has already been pointed out, it is impossible to draw any conclusions with regard to the conditions of canines in preceding stages, for even in recent anthropoids, diastemata in upper and lower jaws may be completely absent, despite the really tusk-like canines. The fact that such an occurrence is rather common, especially in orang, is proved by Selenka's (1898–99) statement. He found that in the upper jaws of female orangs a diastema was missing in 30%, and in lower jaws in 34%. The percentage derived for the male orang is smaller, but nevertheless was found to be missing in 18%.

The quotation is given at length since Weidenreich is clearly minimizing the value of a diastema as an ancestral trait. He stresses the fact that in quite a substantial percentage of anthropoids there is no diastema even in the maxilla. In the limited number of ape crania that the writer has had the opportunity of handling, not one was without a marked maxillary diastema. The cooperation by letter of the Museums in Sydney, Melbourne and Adelaide was enlisted in testing the truth of the statement attributed to Selenka. Thirteen adult orang skulls disclose marked maxillary diastemata in every instance. There is no trace of support here to the statement attributed to Selenka.

Turning our attention once more to the examination of the human primary dentition, in order to see if there is any indication of a diastema which may serve as a guide in the search for such a primitive feature, let us examine the models which we have already found helpful and instructive in the discussion on canines.

In plate 3 B there can be not the slightest doubt that on both sides there is a maxillary diastema for accommodating the lower canines. On the left side this diastema is 1.9 mm mesio-distally, on the right, 1.8 mm. These diastemata obviously are associated with the mode of occlusion of the upper and lower canines. The combination of features here, though not identical with the simian condition, is obviously somewhat akin. Nor are these diastemata as large as can be seen in other youthful patients who present themselves at times.

The writer feels confident that there will yet be found in fossil form a primate ancestor of man with a permanent dentition containing relatively much larger canines than are seen today, similar to those of the deciduous dentition in shape and mode of occlusion, fitting into diastemata of the same type. At least, certain intermediate stages should present themselves.

Before leaving the discussion on canines and diastemata and the evidence of primary dentition, we must note one very fundamental difference between man and the anthropoid apes. In the former the secondary canines are relatively smaller than the primary canines; in the latter they are relatively larger.

Last, brief reference must be made to the fossil ''man-apes'' of South Africa. Gregory and Hellman ('39) had just completed their work on the teeth of these forms when the work described in these pages was being finalized. Since then it has been my privilege to receive some beautiful casts from Dr. Broom (Transvaal Museum, Pretoria, S. Africa) of the dental tissues and surrounding bony structures of Plesianthropus and Paranthropus and they are undoubtedly an astonishing combination of features. Dr. Broom was also good enough to send the May and June issues of the Annals of the Transvaal Museum (1939). The former contains Dr. Broom's description of the dentition of Plesianthropus and Paranthropus; the latter, the work of Gregory and Hellman on these Primates.

Plate 4 (above) is a reproduction of the upper dental arch of Plesianthropus transvaalensis. Certain traits are clear and are pointed out by Gregory and Hellman.

The upper canine "is actually smaller in its transverse diameter than the first premolar, whereas, even in female apes, it is normally larger than that tooth. Moreover, its crown, although somewhat worn off at the tip, is not dagger-like as it is in typical modern female apes, but altogether more like a human canine" ('39, p. 561).

There is not the slightest trace of a diastema, and the strong similarity in certain regards to the human dentition is obvious from the illustration.

Gregory and Hellman state ('39, p. 560) that Plesianthropus presented such an astonishing mixture of ape and human characters, that for a long time they were in doubt whether to call it a very progressive ape or a very primitive man. The conclusion drawn by these scientists is that the South African Pleistocene man-apes were in both a structural and a genetic sense the conservative cousins of the contemporary human branch.

This finding in no sense militates against the writer's convictions concerning the ancestral canines. But it does indicate that the older acceptance of the anthropoid ape type as the ancestral human form has been rather too rigid in its application.

THE FIRST DECIDUOUS MOLARS

Many years ago, the writer in removing the maxillary teeth from a patient, observed that all 4 premolars had 1 lingual and 2 buccal roots. Most unfortunately any possible significance of this phenomenon was lost on the writer, who was only superficially interested in physical anthropology at the time. Hrdlička ('24, p. 123) has stated that "The crown of the human tooth even in its minute details represents but little that is fortuitous. It is the resultant of inherited ancestral conditions, modifying further by evolution and involution."

Whether this be true or not, it does seem a remarkable coincidence that a condition apparently resembling the anthropoids in all 4 maxillary premolars should have existed in a modern European. The writer has seen no reference to any other instances of this nature, but Dr. Campbell of Adelaide in a private letter states that this phenomenon is not really rare.

Human first premolars in the maxilla have 2 roots, and second premolars 1 root, as is well known. The upper premolars of the anthropoid apes all have 3 roots, 2 buccal and 1 lingual, as in the molars.

What are we to look for in the upper premolar area as indicating an ancestral human condition? Examination of the first deciduous molar, and of the first permanent premolar of the anthropoids discloses less difference superficially than exists between the corresponding human teeth. The writer is inclined to think that the teeth which are called deciduous first molars are really a specialized form of tooth of a premolar type.

When a human maxillary deciduous first molar is viewed from the buccal side, the crown has its greatest gingivo-occlusal height over the anterior buccal root (plate 3 C). The first permanent premolar in the apes has exactly the same appearance (plate 3 D). It is evident too in the lateral view of the Dryopithecus maxillary dentition (plate 4, below).

Black (1892, p. 96) states that the deciduous first upper molar has 3 lobes or cusps, mesio-buccal, disto-buccal and mesio-lingual, and 3 grooves, buccal, lingual and distal. He considers that in their form and cusp design they are peculiar to themselves. Careful examination of the occlusal surface of a human upper deciduous first molar discloses the condition described below. This is illustrated by diagrams made from photographic enlargements of 2 different teeth (fig. 1), and in order to accentuate the features the occlusal surface was pencilled in such a manner that the depressions remained unmarked. The diagrams are intended to display clearly the features as they are seen by the writer.

The protocone, paracone and metacone are quite apparent, bounded by an equally diminutive disto-lingual groove. From the central pit, the mesial groove runs forward. The buccal groove runs laterally and the distal groove posteriorly, passing over the oblique ridge which connects the protocone and the metacone in any normal upper molar. The mesio-buccal triangular groove (anterior fovea) running from the mesial end of the mesial groove is quite clear. The disto-lingual groove is diminutive and clearly outlined.

Our study of the occlusal surface throws light on the premolars. We discern only a small metacone, and a diminutive

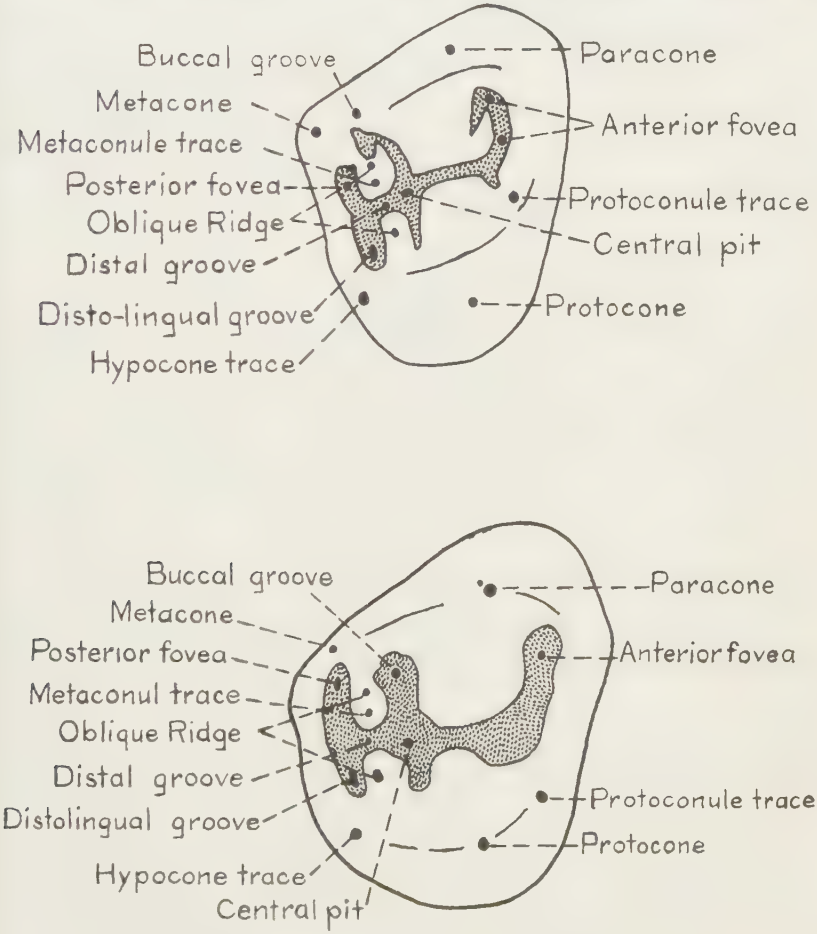

Fig. 1 Diagrams of the occlusal surfaces of 2 human upper deciduous first molars.

vestigial trace of the hypocone. Again the mesial groove, the buccal groove and its slight lingual prolongation, and the anterior fovea clearly display the general outline of the occlusal grooves of the upper premolars.

Of this there can surely be no doubt. So that we might perhaps infer that the disto-buccal root has vanished along with the metacone and hypocone. If these deductions be sound, the human first premolar preserves the mesio-buccal and the lingual roots. In the anthropoid apes all 3 roots remain, this presumably being the more primitive condition.

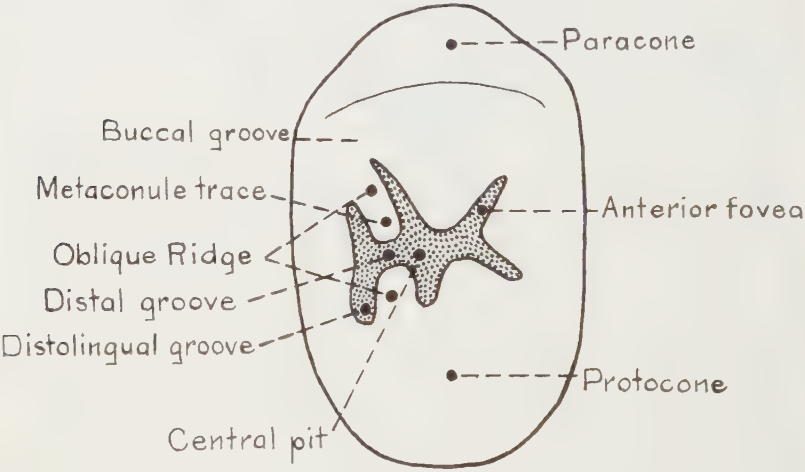

Fig. 2 Diagram of the occlusal surface of a human upper second premolar.

Let us now examine the occlusal surface of an upper second premolar which has been pencilled in the manner described earlier.

The fissures or grooves show up clearly and the diagram based on photographic illustration (fig. 2) is most interesting. It will be seen to be very similar to the pattern of the deciduous first molar depicted earlier. From the central pit, the mesial groove runs forward and turns labially to become the anterior fovea. The buccal groove runs from the central pit but soon loses itself. The small ridge behind is what remains of the oblique ridge connecting the metacone and protocone.

This is cut by what represents the distal groove in the normal molar pattern. Behind this lies a small lingual groove, the buccal end of which is what remains of the posterior fovea, the groove itself being representative of the disto-lingual groove. There seems to be no trace of a hypocone element.

In order to see these features it is necessary to pencil the occlusal, and the tooth must be undamaged on this surface. Opportunities are not very frequent for examination, as sound teeth are not often extracted. Again, the appearance is not uniform by any means, but although the writer has expected to find in a first premolar the appearance described, his search has so far failed. In second premolars, he finds it so frequent as to be commonplace. The fact that the resemblance which has been described exists at all, is submitted as a phenomenon worthy of further investigation.

MAXILLARY DECIDUOUS SECOND MOLARS

Black, Gregory and others seem to be unanimous in regarding the upper deciduous second molar as a facsimile of the upper permanent first molar. Superficially, the resemblance may seem to be perfect, but certain important differences manifest themselves after suitable specimens are carefully examined.

Figure 3 shows 2 diagrams based on photographic representations of a maxillary deciduous second molar which are intended to portray features that are readily observed in the specimen but which are not nearly so manifest in a photograph.

The upper deciduous second molars are quite often a perfect example of the Dryopithecus molar pattern. The features may be briefly set out as follows:

1. The cusps are high.
2. The grooves or fissures are deep.
3. The protoconule and the metaconule are more clearly differentiated.
4. Carabelli pits (to use Weidenreich's term) are frequent.

The first and second features are all important, for 1 essential difference in the crowns of the anthropoid permanent molars, as compared with those of man, is the greater height of the cusps and consequently greater depth of the grooves and pits. There can be no doubt that in the apes this condition is associated with a form of mastication practically straight up and down.

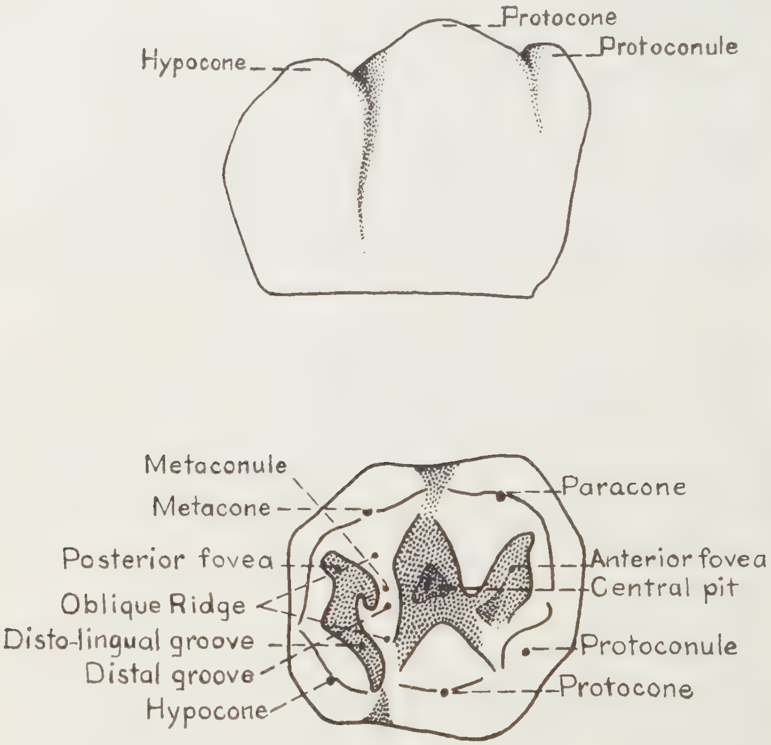

Fig. 3 Diagrams of the lingual and occlusal surfaces of a human upper deciduous second molar.

The third feature is one to which Gregory and Hellman ('26, p. 11) call attention as a feature of primitive primate molar occlusal area, and many human upper deciduous second molars display these 2 small crested cusps.

No less interesting is the situation disclosed by a study of the other deciduous molars, and the writer would draw attention to 3 features which can be verified easily, and which are full of interest. First, the upper deciduous first molar of the orang is much more like the corresponding human tooth, than is that of the chimpanzee. And yet the chimpanzee is generally accepted as showing the greatest affinities with man. Secondly, the upper deciduous second molar of the orang is less sectorial in appearance than the corresponding human tooth. Thirdly, the resemblance between the human lower deciduous first molar and the lower permanent second premolar of a female gorilla is quite astonishing, and recalls the fundamental similarity in the occlusal surface of the human maxillary deciduous first molar and the human maxillary permanent second premolar, attention to which was drawn in a preceding section.

It is realized that this work is not a comprehensive survey of the deciduous dentition of the primates. It was the intention of the writer to pursue his research in this field but the outbreak and long duration of World War II has quite prevented anything of this nature. Nor does there seem to be any possibility, despite the lapse of several years, of any further work of this nature by the writer. So he has deemed it best to make available the labors of the preceding pages in the hope that whatever originality may be contained in them may make its appeal where destined.

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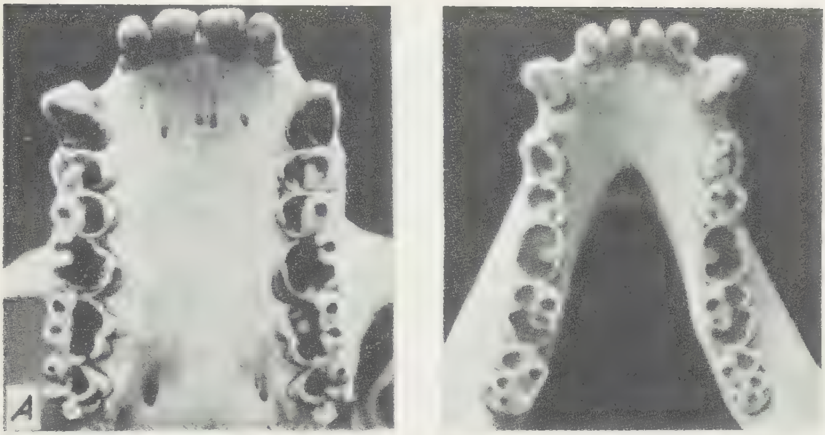
PLATE 1

EXPLANATION OF FIGURES

A. Maxillary and mandibular dental arcades of a gorilla, showing characteristic wear. B. Front and side views of the jaws of a male gorilla showing worn anterior teeth with the posterior teeth retaining their cusps. C–D. Models of the temporary dentition of a white child, 4 years old. Unshaded parts of mandibular teeth in D show where the maxillary teeth occlude.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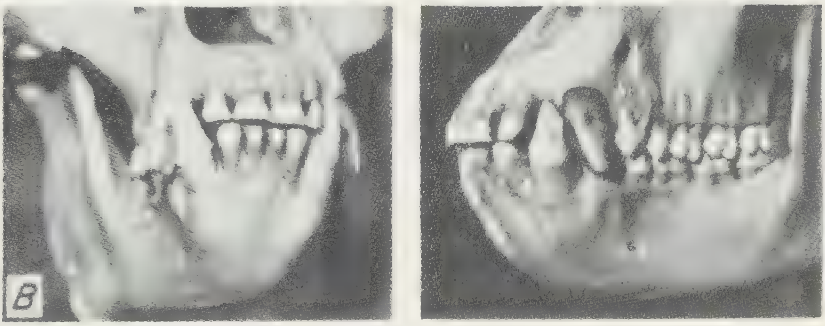
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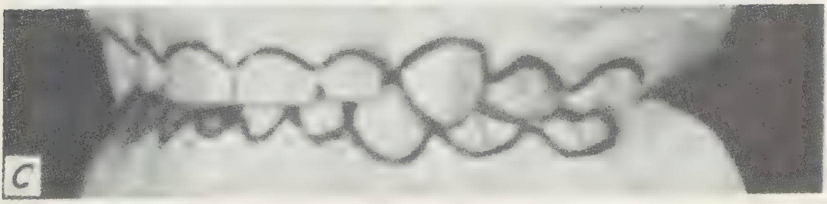
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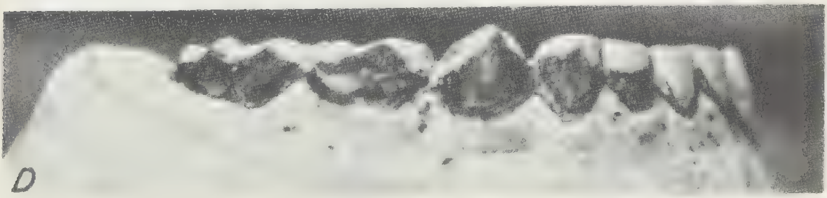
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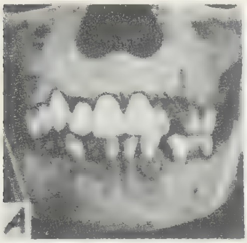
PLATE 2

EXPLANATION OF FIGURES

A. Two views of the jaws of an aboriginal Australian child with over-bite. B–E. Views of the jaws of 4 adult aboriginal Australians. In B there has been ablation of the upper incisors; in C there is a definite over-bite of the upper anterior teeth; in D there is a slight over-bite; and in E there is an uncommon relationship between the anterior teeth with marked wear of the posterior teeth. F. Two views of the jaws of a baby chimpanzee showing edge-to-edge bite.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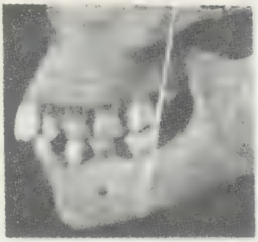

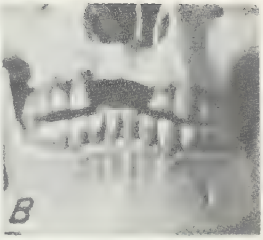
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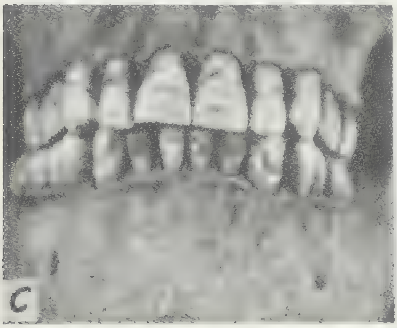
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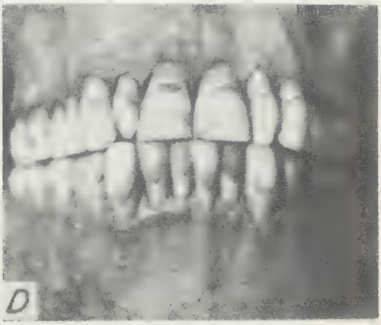
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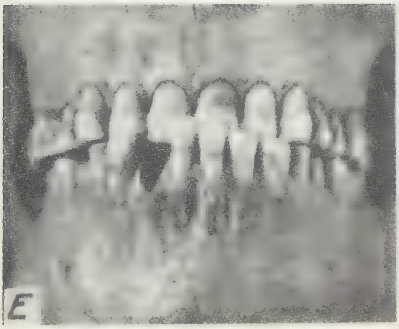
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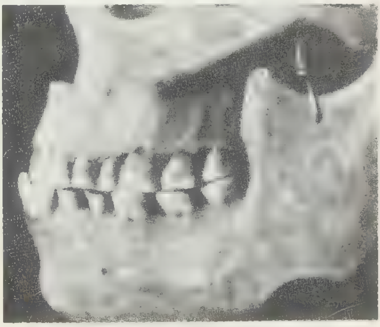

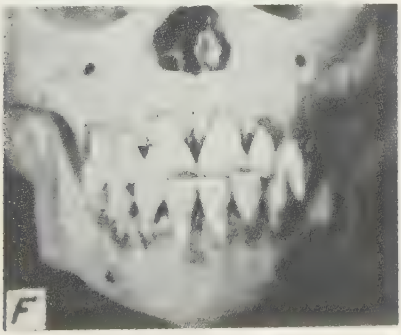
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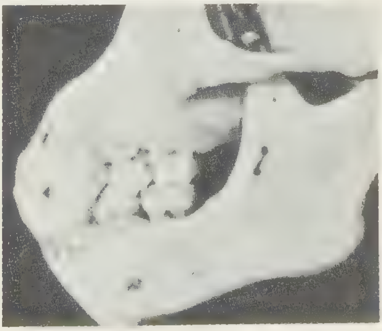
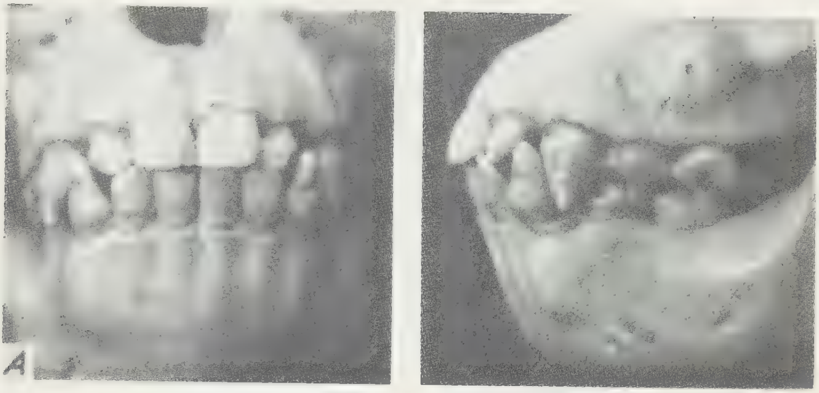


PLATE 3

EXPLANATION OF FIGURES

A. Two views of the jaws of a baby orang with oblique overlapping central incisors. B. Two views of same model shown in plate 1 C illustrating diastemata in a human primary dentition. C. Buccal view of a human maxillary deciduous first molar. D. Buccal view of maxillary permanent first premolar of a gorilla.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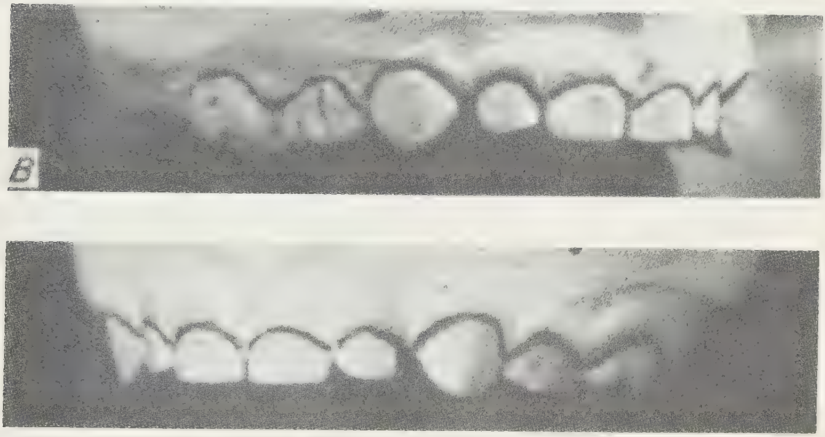
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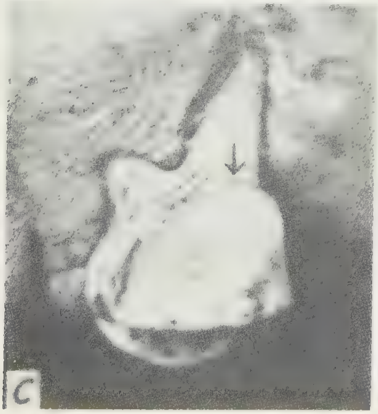
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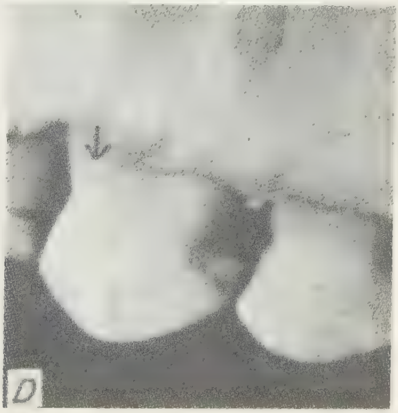
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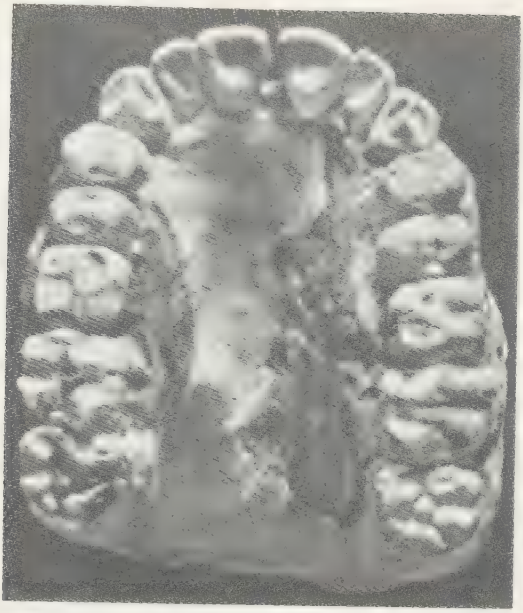
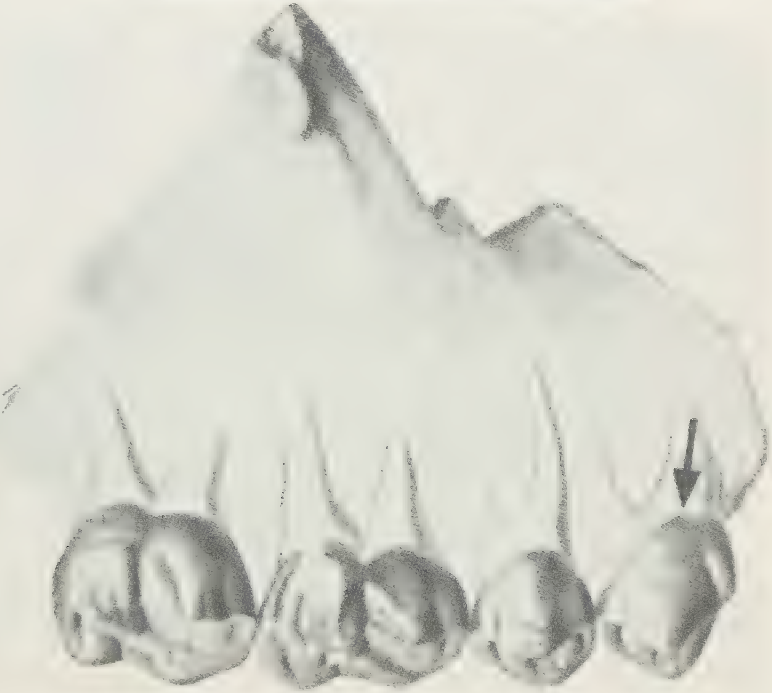
PLATE 4

EXPLANATION OF FIGURES

Above: Upper dental arch of Pleisanthropus transvaalensis (Gregory & Hellman, '39, fig. 5 B). Below: Lateral view of the Dryopithecus maxillary dentition (Gregory & Hellman, '26, fig. 8 (2), after Pilgrim).





Genetic Differences in Mental Capacities.— In human societies conditions have been neither rigid nor stable enough to permit the selective breeding of genetic types adapted to different statuses or forms of social organization . . .

The process of natural selection in all climes and at all times [has] favored genotypes which permit greater and greater educability and plasticity of mental traits under the influence of the uniquely social environments to which man has been continuously exposed.

The effect of natural selection in man has probably been to render genotypic differences in personality traits, as between individuals and particularly as between races, relatively unimportant compared to their phenotypic plasticity.— Th. Dobzhansky and M. F. Ashley Montagu. Natural selection and the mental capacities of mankind. Science, vol. 105, 1947, pp. 587–590.

New Concept of Evolution.— The older evolutionists of the nineteenth century often spoke of the theory of evolution as the "development hypothesis." Soon, however, it was agreed to use the term "development" for the changes which take place in the human womb and which convert the ovum into a fully formed child. The term "evolution," on the other hand, is applied to the changes which occur in the people of a tribe or of a nation as they pass generation after generation, on this earth, through the womb of time. If, as the result of an injury, the womb casts out its fruit, then development comes to an end. If a tribe or nation is attacked, scattered, or kept in subjection, then, so far as regards that tribe or nation, evolution has come to an end. In order that favorable evolutionary changes may accumulate, and so strengthen the tribe or nation, the integrity of that tribe or nation must be defended through hundreds of generations. Man's nature—his passions, his feelings, his emotions— has been molded, has been evolved, for this main purpose — viz., to maintain and to defend the life and the integrity of the tribe or nation to which he belongs. From this you see the approach which I am making to the problem of war. I am to regard it as part of the "machinery" of evolution. This is a heresy for the majority of anthropologists.— Sir Arthur Keith. *Evolution and ethics.* G. P. Putnam's Sons, N. Y., 1947, ix + 246 pp. ($3.00).

OBSERVATIONS ON SENSE OF SMELL IN CHIMPANZEES

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In recent years a great deal of research work has been carried out relating to the mentality and behavior of chimpanzees; and although the results of numerous sight tests have been recorded, remarkably little attention appears to have been given to the sense of smell in these animals.

Kohler ('25, pp. 279, 282) reported upon experiments regarding sense of smell which he conducted with a group of several young chimpanzees at the Anthropoid Station at Teneriffe, during the period 1913–1917. He came to the conclusion that in anthropoids the sense of smell is very limited. He appears to have been led to that conclusion chiefly by the fact that a piece of fruit was not discovered by that means when but 2 dm distant.

Since that time but slight notice appears to have been taken of this subject.

Yerkes ('29, pp. 322–323), who referred to Kohler's experiments, while expressing agreement with Kohler's opinion that keenness of smell in the chimpanzee is low, suggested that Kohler probably underestimated both the efficiency of this sense and its importance to the animal and expressed the inclination to believe that in the chimpanzee the degree of smell, and its usefulness, are probably comparable to that of man. He does not, however, appear to have had any direct evidence available to support this view, for he did not produce any.

After 5½ years' acquaintance with 3 chimpanzees, during most of which time I have frequently had 1 or more of them with me under conditions that allowed them ample opportunity for self expression and a liberal amount of freedom, I find myself in disagreement with both these observers, the only authors whom I have found to give a definite opinion upon this subject.

My records refer to the behavior of 2 young male chimpanzees, Whoopee and Butch, who were, when I first came to know them, 4½ years, and 3 years of age, respectively, and to 1 female, Mary Ann, who is Whoopee's senior by about 2½ years.

All 3 of the chimpanzees were frequently seen to touch lightly the tip of 1 finger upon some unfamiliar object, and then put the tip of that finger momentarily near the nose. This method of examination was by no means confined to inanimate objects for it was of frequent occurrence for them to employ it in the case of strange persons who might be standing close to the wire of their cages, by touching a person's hand in the same way and then putting the same finger to the nose. When such an incident caught the eye of the recipient of this attention it generally caused mild amusement; but in most cases it apparently went unnoticed, both by the recipient of the attention and by others present for it was usually performed with very little obtrusion. It was also adopted in the case of dogs, and any birds, chiefly pheasants and doves, which I sometimes held near them.

My observations on this subject have been restricted to those chimpanzees of my acquaintance in recent years, but it seems likely that others may have acted in the same manner without attracting particular attention. This habit of sampling odor appears to be practiced by other anthropoids.[1]

A notable instance of this kind occurred after a swing had been replaced in the big play cage. This swing consisted of a hoop of ¾-inch pipe, about 24 inches in diameter, welded to a loop to which was attached a strong steel chain. By carrying the hoop up the pole in the center of the cage and passing it over and around 2 horizontal bars, Whoopee had used up all the chain, and then, by using the hoop as a lever, had broken the welding. As repairs could not be effected at the time, the swing had been left for several weeks in the repair shop; until, finding one morning that the necessary welding had been done, I erected the swing again in its accustomed place.

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[1] Benchley ('42), pp. 85–86) mentions a similar action on the part of an orang-utan.

Whoopee and Butch were left in their living cages later than usual that morning and although they were unable to see the large cage from there, they watched as I passed carrying the swing and the necessary tools with me. A short time later, when I took Butch out to the cage, he at once hurried to the newly erected swing, which was hanging 3 or 4 feet above the floor. As he approached it he stood up, placed the tip of 1 finger lightly upon the iron loop and then put it near his nose momentarily. He appeared to be quite satisfied with whatever result he got from that test, for, without touching the hoop again, he walked in a leisurely manner to the wire side of the cage 10 feet away, and climbed up the wire. Upon reaching some horizontal bars 13 feet above the floor he walked erect along the bar from which the swing was hanging, leaned down and placed a finger upon the chain where it was attached to the bar, and put that finger, as before, near his nose. Seeming, then, to be satisfied with his examination, he climbed down and proceeded to play, without giving the swing further attention.

Whether Butch wished to ascertain if it were I who had erected the swing, or to find whether it was the same swing, or of similar material, I am unable to say. But his actions indicated definite mental activity on his part and seem to show that he had reason to think that he might find, in the form of a faint trace of odor, evidence which to us, with our limited sense of smell, would be beyond perception.

Our chimpanzees had not been accustomed to associating with the dogs, and it was obvious that they had an aversion to any contact with them; although they delighted in rousing the dogs into a demonstration of their capacity for noisy behavior. I frequently tried to bring about a more friendly feeling between Butch and Balloon, the Great Dane. Balloon was a quiet old dog, and was often allowed the privilege of running outside the kennel yard, spending most of the time sleeping wherever he could find a shady place and a soft bed. Often when he came near, and Butch was with me, I called Balloon and tried to induce Butch to play with him, taking Butch's hand and stroking it gently over Balloon's head or back. Although Balloon showed no impatience beyond a desire to trot off quietly to some shady corner, Butch clearly showed that any contact with him was distasteful. Whenever he was allowed to follow his own initiative his first action was to put the tip of 1 finger on Balloon's back, and then near his own nose. This was followed immediately by the delivery of a forceful smack on Balloon's back, as though to dismiss him. Balloon always took this treatment patiently enough and trotted off as though fully aware that his presence was not pleasing to Butch and he was glad to be going on his way.

Although this last instance does not, perhaps, provide such convincing evidence of a keen sense of smell as those already presented (for even we might, in such case, find this test effective), it serves to show that the action of placing a finger upon an object and then near the nose was for a definite purpose, was in regular use, and was used in some cases where we would be able to detect a trace of odor.

Other, and far more convincing, evidence of a keen sense of smell in chimpanzees became obvious when the 2 young males, on numerous occasions, obstinately refused to settle down for the night when given newly washed blankets on which we could detect no trace of odor.

The blankets were spread out each morning on a clean concrete floor, sloping and well drained, and thoroughly washed with a powerful jet of water, turned over during the process, and afterwards hung upon a line to dry, usually in a light wind and direct sunlight for several hours. On being brought in during the early evening they were usually quite dry but whenever there was any doubt on this point other blankets were used in their place. For many weeks we were puzzled to account for the fact that, on several separate occasions, both Whoopee and Butch, when being shut up for the night in their sleeping boxes, refused to lie down on the blankets. I arranged the blankets in the manner which I knew they both preferred. A small one folded and spread on the floor of the box, with a larger one bunched up and arranged in a circular form, in such a way as to resemble the upper edge of a bird's nest, to serve as a pillow, and at the same time support their arms and legs as they sprawled within the circular rim, only to find that they both refused to accept the blankets. Instead of doing so they snatched them up, held them to their noses, and threw them down. Butch, the younger and more impatient of the 2, was always the more demonstrative in this, as in other matters, and he always shook his head vigorously from side to side when he threw the blankets down, as though to tell me they were not clean; and when I insisted upon his lying down upon them he at once sprang up, jumped around, and threw the blankets around in the box. On 2 occasions, when I lifted him up and laid him down a second time upon them, he showed his determination by again springing up, shaking his head violently, and tearing the blankets with his hands.

After several isolated occurrences of this sort, it was found that the objectionable smell, which we ourselves, and others whom we consulted, were unable to detect, was due to a boat in process of painting in the dry-dock, usually 15 or more feet away, and never less than 10 feet, from the blankets. The dry-dock was a large and lofty building, fully open at each end. It was just within one end of this building that the blankets were always hung to dry, under shelter of the roof but exposed to full sunshine most of the time; and there was nearly always a breeze blowing through the building from the end in which the blankets were hung.

The adult female chimpanzee did not provide any similar evidence, for the reason that she was provided with burlap bags instead of blankets on which to sleep. These were never hung in the dry-dock to dry.

Is it not reasonable to imagine that this objection to such a faint odor may have been due to an instinctive dread of danger from settling down for the night upon bedding which, although of familiar material, was permeated by an unknown odor, giving rise to instinctive suspicion of the presence of an enemy?

Considering that in their wild state chimpanzees are said to travel through the forest, stopping to rest in a different place each night, is it not reasonable, also, to assume that they are careful to select, for such purposes, a location that appears to be free from any evidence, either of sound or of scent, of the presence of any of their known natural enemies, from which they must be ever on the alert?

We know that most animals leave behind them sufficient odor to be detected by others that are endowed with a well developed sense of smell and it seems likely that quite as much alarm might be occasioned by the presence of a scent that is quite unknown. It seems likely, also, that the sense of smell in these animals may be of more service to them for this purpose as a means of defense, than in any other way. It was apparent that these same animals, when allowed to search outdoors for food, consisting of various fruits, nuts, or green food, depended upon sight, just as we would in like case and we might expect that in the wild state they find sight far more practical and effective than scent, when searching for food.

Whoopee and Butch did not show any objection to the smell of fly-spray. The reason probably being that, knowing full well the source of the smell, and the purpose for which the product was used, no feeling of suspicion was aroused. I frequently noticed the presence of mosquitoes in the sleeping boxes at bed time, and at such times used a spray-gun, waiting only 2 or 3 minutes for the smell to go before putting the blankets in and closing the boxes for the night, and neither of the young apes showed any objection to the smell. Butch, especially, was interested in those proceedings. He often called my attention to the presence of mosquitoes by grabbing at them with his hands as they flew and when I brought the spray-gun he begged, by clapping his hands, to be allowed to use it himself and he made a very thorough job of it by working the spray-gun vigorously until I took it away from him.

Nor did they show any great dislike for the smell of ordinary paint, for they knew the source of that smell. But the paint used upon the boats was of a special kind, with a different odor and was used some distance away from their cages. On one occasion Butch found a pot of red paint with a brush and when we found him he had already smeared it around, and his hands and legs were well messed up with it. At another time, after the front of Butch's cage had been rebuilt, I found that, against my wish, the new wooden uprights had been covered, inside and out, with green paint. Upon seeing this I kept Butch away from the new paint all the next day, but he scraped the paint with his teeth on the first opportunity, the result being that his front teeth all had the appearance of having been covered with green enamel. I found it necessary to clean the paint from each tooth separately with a rag moistened with turpentine, to which process he submitted patiently.

For some time Butch occupied a cage some distance away from the other 2 chimpanzees and I was in the habit of taking fruit with me whenever I visited him. On one occasion it was growing dark when I left and as I had 2 oranges remaining, which I considered better for him to receive early next morning, I got Butch to hand me 2 burlap bags upon which he was in the habit of sleeping. I shook the bags, as I often did before telling Butch to remake his bed and after returning the bags to him and waiting until he had settled down for the night, I carefully placed a third bag, containing the 2 oranges in a corner of the cage at a distance of 6 feet from where he lay. Butch knew oranges came from a source outside his cage, he was obviously sleepy, and it was fast becoming dark, therefore I did not expect him to find the oranges until he began to move around in the morning but hoped that he would find them as a result of disturbing the bag, or of lying upon it. When I visited Butch again at about 2 o'clock the following afternoon, and told him to hand me the bags, it was much to my surprise that I found that the oranges had not been discovered. No child, upon seeing a conjurer produce a rabbit from within his hat, could show more surprise and delight than Butch evidenced when, after receiving the bags from him, I shook the last one in front of his cage, and the 2 oranges rolled out upon the grass. It surprised me, not that Butch had not discovered the oranges by means of scent, but that during the 8 hours or so of daylight they had remained undisturbed in his cage.

After that, although I once succeeded in hiding 3 small oranges beneath some dried banana leaves in the corners of Butch's cage when he was settling down for the night, they were all gone when I visited him at about noon the following day and none afterwards remained undiscovered for more than a few minutes when concealed in burlap bags, although the bags possessed a peculiar odor of their own. Butch showed that he did not depend upon the sense of smell in such matters, and also that he had an excellent memory. For several weeks afterwards he always brought the senses of sight and touch into use in a thorough search for anything that the bags might contain; standing up and holding each bag wide open while peering into it, and sometimes inserting one arm up to the shoulder and feeling within.

It seems probable that these apes do not habitually make use of the sense of smell in searching for food when in their wild state; sight being usually much quicker and effective in searching for the fruits and green food upon which they mostly feed. This might lead to a predisposition not to do so when kept under artificial conditions. It was probably unprecedented for oranges to be surreptitiously concealed within Butch's cage and for that reason we should not expect him to suspect their presence, merely from noticing their odor, any more than we would ourselves search for the source of the smell within our own bedroom if, upon awaking some morning, we detected the smell of fried bacon emanating from a neighbor's near-by apartment. The orange smell was quite familiar to Butch, and therefore caused him no uneasiness. But, noticing the odor, and seeing only scraps of peel around, he saw no indication of anything unusual, and perhaps, guided by former experience, anticipated the arrival, sooner or later, of someone bringing him fruit of that kind.

We should remember that apes are guided, in their behavior regarding matters of this kind, largely by their former experience, just as we would be, and we should not take it too much for granted, when making experiments such as those described by Kohler, that the animal is aware that something unusual is on hand, and that he is expected to exert his best effort for purposes of the record, with his reputation as an intelligent animal at stake.

Throughout the 5½ years of my acquaintance with the 3 chimpanzees, I seldom knew them to obviously test the smell of any kind of fruit with which they were familiar, as we ourselves might do, before eating it. This, however, need not be taken as evidence that they do not possess this sense in a high degree. On the contrary, it seems reasonable to believe that with every kind of food with which they are familiar (so far from having to hold it to their nostrils) they may be able to detect its odor very effectively without putting it close to the nose.

Although all 3 of the chimpanzees sometimes rejected cooked cereal and other foods of which they were not particularly fond, they often did so without the preliminary act of holding it before their nostrils; but if we tried to induce them afterwards to eat it, they often held it ostentatiously to their nostrils before handing the container back to us as though for the purpose of acquainting us with the reason of their rejecting it. And if we again tried to get them to eat the food they either placed the container on the floor and left it there, or inverted it and emptied the contents upon the floor. An even more effective way of ending the argument.

One notable exception to their custom of not visibly sampling the odor of fruit, occurred when I presented each of the 3 with a kind of fruit which, it appeared certain, was entirely new to them. Two trees of Sapodilla *(Sapota achras)* grow near my door, and are the only trees of the kind known to me here in Honolulu. Their fruit has fallen each season, and remained unnoticed by my neighbors, apparently without being recognized as being edible, during the 12 years that I have known these trees. Upon my showing this fruit recently to several persons of my acquaintance, none, with the exception of a professional botanist, was acquainted with it, or knew of its edible nature. I mention this in order to show that, as this tree is a native of tropical America, and is almost unknown here, it is extremely unlikely that our 3 chimpanzees (2 of whom were brought here from Germany when but a few months old, and have not been within several miles of these trees) had seen its fruit before.

Thinking, a short time ago, that such must surely be the case, I decided to see what reaction the apes might show on seeing this fruit, which, with its rough outer surface of russet brown, is so unlike other fruits that they know. Each animal was approached separately, and in each case their behavior was the same, although from their separate cages they were unable to see one another. Each took the fruit when I presented it, and, without putting it close to its nose, examined it slowly and carefully by sight, as though the object was under suspicion. It then carefully broke the fruit open, holding it between the thumb and fingers of both hands, just as we might do. Each then slowly held the fruit about ½ inch from the nostrils, and then put it to its lips and tasted it, obviously still regarding it with a great deal of suspicion;

but in spite of its remarkably sweet taste they still refrained from eating any. Then they paused, as though undecided upon their course of action, and remained holding the fruit in their hands and looking at me, as though for guidance. In each case I waited a few seconds, until it seemed likely that they would discard the fruit. Then, upon my telling them to eat it, assuring them by repeating the word "good," and showing an example by eating a portion of a similar fruit, each of them sampled a small portion, and then ate all of the sweet interior. They all appeared to like the new fruit and the next time I offered it to them they all ate it without hesitation, and begged for more.

The incidents recorded herein have led me to believe chimpanzees possess a very keen sense of smell. It seems certain that they do not usually have need of this sense in searching for such food as they subsist upon but it is probably of very great importance to them in warning them of the presence of predaceous animals as they travel through the forest with their environment continually changing. And more especially, perhaps, it serves them by giving warning of the presence of their natural enemies in places that might otherwise be chosen for their nightly rest. Should this supposition be correct, it fully explains why such a faint trace of odor of a particular and unusual kind of paint upon their sleeping blankets should have been so objectionable, and apparently caused suspicion and alarm to both of the young apes, who acted each time independently, and out of sight of one another.

This subject seems to call for further investigation by others having facilities for research work of this nature, which might either confirm or disprove this conjecture.

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BENCHLEY, BELLE J. 1942 My Friends the Apes. Boston.
KOHLER, WOLFGANG 1925 The Mentality of Apes (second revised edition). New York.
YERKES, ROBERT M. 1929 The Great Apes. New Haven.

Viking Fund Fellowships in Anthropology.— By way of promoting research especially among young scholars, provision has been made by the Board [of Directors] for a series of Viking Fund Fellowships in Anthropology . . . Candidates interested in applying for fellowship grants should write to the Director of Research [Dr. Paul Fejos, 14 East 71 St., New York 21, N. Y.] for application forms.—

Catalogue of Anthropologists.— The Viking Fund's Catalogue of Anthropologists and compilation of bibliographical material . . . constitutes a valuable source of reference. During July, 1946, a form letter was sent to 100 U. S. anthropologists requesting records of their personal bibliography, and of these 68 responded. It is hoped that those who have not yet replied and others who may not have been reached will communicate with the Fund's library [14 East 71 St., New York 21, N. Y.] in the course of the current year.— Report of the Fund's activities for the year ended January 31, 1947, 75 pp.

Editorial Council.— At the recent first meeting of the Executive Board of the American Anthropological Association an informal committee to be known as the Editorial Council, and consisting of the editors of the journals mentioned below in parantheses, was appointed for the general purpose of providing opportunity for consultation regarding problems common to the publication of journals having national or international scope in anthropology.

J. Alden Mason (American Anthropologist) 1888.
Wayland Hand (Journal of American Folklore) 1888.
C. F. Voegelin (International Journal of American Linguistics) 1917.
T. D. Stewart (American Journal of Physical Anthropology) 1918.
John M. Cooper (Primitive Man) 1928.
Irving Rouse (American Antiquity) 1935.
Conrad Arsenberg (Applied Anthropology) 1941.
Ralph Beals (Acta Americana) 1943.
Leslie Spier (Southwestern Journal of Anthropology) 1945.

PHYSICAL CHARACTERISTICS OF FUEGIANS

AN ANALYSIS AIDED BY PHOTOGRAPHY

ALEXANDER LIPSCHUTZ, GRETE MOSTNY, HANS HELFRITZ,
FIDEL JELDES AND MARGARET LIPSCHUTZ
Chilean Scientific Mission for the Study of the Fuegian Indian [1]

FOURTEEN PLATES

INTRODUCTION

Standard anthropometric techniques have limited applicability to small populations undergoing miscegenation. This is true particularly in the case of the Fuegian Indians, now reduced to probably no more than 200 individuals, representing 3 tribes — Ona, Yámana and Alakaluf — and ofttimes mixtures among themselves and with Whites. We feel that under these circumstances, photography offers a very good means of conveying an impression of the physical characteristics of such a population. Accordingly, we are presenting here an analysis of Fuegians based on photographs.[2] We hope thereby to throw light on the question regarding the supposed Australoid infiltration into this part of the American

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[1] Under the auspices of Universidad de Chile, Dirección General de Informaciones y Cultura, Departamento de Medicina Experimental del Servicio Nacional de Salubridad, and Museo Nacional de Historia Natural. Prof. Lipschutz, Departamento de Medicina Experimental, was chief of the Mission; Dr. Mostny represented the Museo Nacional; Mr. Helfritz, the Dirección General de Informaciones y Cultura; and Mr. Jeldes the Instituto Chileno de Criminología.

[2] Photographs were secured on a total of 67 individuals, subdivided as follows:

	INDIAN	MESTIZO
Ona	5	14
Yámana	19	12
Alakaluf	9	8
Total	33	34

continent. The idea of such an immigration, which has been advanced especially by Rivet ('43, chapters 5 and 6)[3] is based mainly upon linguistic, ethnographic and craneologic evidence, but seemingly fails to take into account the physical characteristics of the living.

The problem before us, then, is whether by careful observation of the features of the Fuegians, controlled by photography, notable differences can be discovered between the Fuegians on one side and the multiform Mongoloid American Indians on the other. In other words, since the writers have seen Indians throughout the continent during upwards of 20 years, can they tell by inspection of the Fuegians whether their complexion, quality and distribution of hair, high cheekbones, slit eyes and other bodily characteristics, are like those of the varied types of American Indians in general? Although we are aware that this procedure is subjective by nature, we feel that our common personal experience should carry some weight.

PORTRAYAL OF ONAS (PLATES 1–4, 14)

Data were secured on 40 Onas (table 1) of whom 20 were met personally. Data on the remaining 20 individuals were collected with the help of other Onas and the Misión Salesiana in Río Grande. The data referring to this second group of 20 individuals are somewhat less reliable than in the case of the Yámanas and are given separately. There were only 5 individuals in the first group with both parents stated to be Onas; in the second group there were 12 individuals who were stated to be of pure Ona parentage.

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[3] This question originated as early as the end of the 16th century. Henrrico Martínez (1606, pp. 104–105) writes: ''También puede ser haber venido gente a estas tierras por la parte del Sur, porque hasta ahora no se sabe que sea tierra despoblada la que hay de aquel cabo del Estrecho de Magallanes.'' Torquemada (1723, vol. 1, p. 30) quotes this sentence of Martínez. Herrera (1730, Déc. prim., p. 10) says: ''muchos creen que la tierra del Estrecho de Magallanes, es continente; y si es así por allí pasó la gente que pobló aquella tierra, por la facilidad del paso que en algunas partes es angosto.'' García (1729, pp. 37, 247), quoting different authorities, also was concerned in bringing people by this southern route into our continent.

Individuals of Ona extraction.

SERIAL NUMBER	NUMERICAL DESIGNATION	AGE	SEX	ETHNIC[1] GROUP	ETHNIC GROUP OF PARENTS		FAMILY RELATIONSHIP	DEGREE OF INDIAN PARENTAGE[2]
					Father	Mother		
Observed								
1	I	42	F	O	O	O		8
2	II	24	F	O	O	O	Daughter of 1	8
3	III	20	F	O	O	O	Niece of 1	8
4	V	31	M	O	O	O		8
5	IV	3	F	O	O	O		8
6	VI[3]	47	M	Y	Ar//O	O		6
7	VII	37	M	O	C	O		4
8	IX	31	F	M	C	O	Mother of 13, 14, 15	4
9	VIII	17	F	M	C	O		4
10	X	?	F	O	S	O		4
11	XII	6	F	?	E	S//O	Children of 10	2
12	XI	4	F	?	E	S//O	Children of 10	2
13	XX	11	M	Ar	C	C//O	Son of 8	2
14	XIX	4	M	Ar	C	C//O	Son of 8	2
15	XIII	2	M	Ar	C	C//O	Son of 8	2
16	XIV	12	F	Ar	W	W//O	Cousin of 13–15	2
17	XVIII	6	M	Ar	W	W//O	Cousin of 13–15	2
18	XVII	13	F	Ar	W	W//O	Sister of 19	2
19	XVI	11	F	Ar	W	W//O	Sister of 18	2
20	XV	8	F	Ar	W	W//O		2
Reported[4]								
21	CXII	70	M	O	O	O		
22	CX	52	M	O	O	O		8
23	CXI	50	M	O	O	O		8
24	CVIII	42	F	O	O	O		8
25	C	36	M	O	O	O		8
26	XCVIII	35	M	O	O	O		8
27	CXIII	35	M	O	O	O		8
28	CIV	35	M	O	O	O		8
29	CV	33	M	O	O	O		8
30	XCIX	27	M	O	O	O		8
31	CVI	26	M	O	O	O		8
32	CII	26	F	O	O	O		8
33	CIX	22	M	O?	I//O	O		6
34	CI	53	M	O?	I	O		4
35	CVII	53	M	O	Ar	O		4
36	CIII	49	M	O?	Ar	O		4
38	CXV	24	M	Ar	Ar	O?		4?
39	CXVI	18	M	Ar	Ar	O?		4?
40	CXVII	11	F	?	E	S//O		2

[1] Symbols: // separates father from mother of respective parent; / separates grandfather from grandmother; ?—ethnic affiliation undetermined; A — Alakaluf; Ar — Argentine; C — Chilean; Ch — Chilote; E —English; I — Italian; M — Mestizo; O — Ona; S — Spanish; W — White; Y — Yámana.

[2] Number of Indian great-grandparents.

[3] Listed also in table 2 (no. 43).

[4] Not seen by the writers.

The 5 Onas of the first group (I to V) classed as Indians [4] correspond fully to the Indian type current in other parts of the American continent. This refers to the straight dark hair, the high cheek bones and the slit eyes.

The distribution of hair in the man (V) is striking (plate 1); the hair grows low on the forehead and almost covers the temples; the upper limit of the hair in the pubic region is a straight line; the space between the pubic region and the navel is free of hair as are also the chest and axillae. This distribution of hair, which in European races is characteristic of the castrate and eunuchoid conditions, has been recognized by Lipschutz and his associates (Oliver, '34, Pi-Suñer and Reyes, '33) as the normal condition of the Araucanian Indian.

The features of this man and of all 4 females (plates 1 and 2; Lipschutz et al., '46, plate 1) correspond in a pronounced way to the facial type of the Indian in South and Central America. They are all frankly Mongoloid. This is true for the man and is even more noticeable in the 2 young women (II and III) and the girl (IV). The woman (I) corresponds to the Patagonian type of South American Indian: she, like the man, is tall in accordance with this type (D'Orbigny, '44, p. 77).

Quite different is the physical appearance of the Onas of the first group sorted as mestizos, with the exception of no. VI, the man born of an Ona mother and an Argentine-Ona father (Ona parentage = 6; see table 2). He would be taken for a pure strain Indian (Lipschutz et al., '46, plate 5). But not so the man no. VII (plate 3). Both he and the remaining 12 Ona mestizos have straight dark hair; there is none with fair hair. But the distribution of hair on the forehead is in general similar to that in European races. This is shown also by the boys in plate 4. These Ona-White mestizos are in no way different from the common popular mestizo type throughout South American countries. Mongoloid features may be found in one or other of these mestizos; for instance, the high cheek bones in the woman no. IX (plate 3).

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[4] We shall distinguish Indians from Mestizos. Indians are individuals whose parents and grandparents, in some cases also great-grandparents, are known to belong or to have belonged to Fuegian tribes. Mestizos are individuals whose parents or grandparents, and in some cases great-grandparents, are known to have white admixture (for details see Lipschutz et al., '46).

Another interesting peculiarity may be mentioned here: the considerable difference in pigmentation of the back and the palm of the hand (plate 14). The nails and fingertips also are lighter than the back. Sometimes the lighter part extends even up to the second joint, as observed in a Yámana woman (plate 14).

PORTRAYAL OF YÁMANAS (PLATES 5–8, 14)

A complete list of all individuals of Yámana extraction about whom data could be secured through personal contact (40 individuals) or through the civil authorities (23 individuals) is given in table 2. This list shows that in only 20 out of 63 cases both parents were Yámana, according to their own statement, or, in the case of children, according to the statements of the father or mother. Nine individuals were of Yámana-Alakaluf extraction and the remaining 34, or 54%, were miscegenated with Whites. It is noticeable that in the 34 cases where there was White admixture, it was the father or grandfather who was White or of White extraction in 33 cases, whereas the mother had some White parentage in only 4 cases.

Only 10 out of 19 portrayed Yámanas were of Yámana parents, the remaining 9 being of Yámana-Alakaluf extraction. These 10 Yámanas supposedly without other Fuegian or White parentage shall be dealt with first.

The difference between Ona and Yámana is considerable. Already in 1832 Darwin (1891, see chapter 10) was fully aware of this difference though he does not give the names of the tribes. The Yámanas we met, and especially the women, were of lower stature than the Onas and differed from them also as to facial traits. Most of the men, though they declared themselves to be of pure Yámana extraction, impressed us as being miscegenated with Whites. See for example the 2 men, no. XXI (Lipschutz et al., '46, plate 2) and no. XXIX (plate

TABLE 2

Individuals of Yámana extraction.

SERIAL NUMBER	NUMERICAL DESIGNATION	AGE	SEX	ETHNIC[1] GROUP	ETHNIC GROUP OF PARENTS		FAMILY RELATIONSHIP	DEGREE OF INDIAN PARENTAGE[2]
					Father	Mother		
1	LXXXIV[3]	78	F	Y	Y	Y		8
2	XXVIII	75	F	Y	Y	Y		8
3	XXIX	72	M	Y	Y	Y	Father of 28 and 29	8
4	XXIII	55	M	Y	Y	Y	Chief of Yámana tribe	8
5	XXIV	45	F	Y	Y	Y	Second wife of 4	8
6	LXXVIII[3]	29	M	Y	Y	Y	Son from first marriage	8
7	LXXXV	52	F	Y	Y	Y		8
8	XXVII	48	M	Y	Y	Y	Father of 9	8
9	XXVI	28	F	Y	Y	Y	Daughter of 8, wife of 35	8
10	XXXI	8	F	Y	Y	Y	Daughter of 9 (first marriage); other children, 30, 31, 32	8
11	LXXXIII[3]	4	M	Y	Y	Y	Son of 8	8
12	LXXIX[3]	42	M	Y	Y	Y		8
13	LXXX[3]	10	M	Y	Y	Y		8
14	LXXXI[3]	9	M	Y	Y	Y	Son of 12	8
15	LXXXII[3]	7	M	Y	Y	Y		8
16	XXI	31	M	Y	Y	Y	Husband of 50, father of 33	8
17	XXII	21	F	Y	Y	Y	Sister of 16, wife of 49	8
18	LXXXVI[3]	26	F	Y	Y	Y	Mother of 46–48	8
19	XXV	10	M	Y	Y	Y	Orphan brought up by 4 and 5	8
20	XXX	32	F	Y	Y	Y	Wife of 28, mother of 21–27	8
21	XXXIV	13	F	Y	Y//A	Y	Child of 28 and 20	8
22	XXXV	11	F	Y	Y//A	Y	Child of 28 and 20	8
23	XXXVI	9	F	Y	Y//A	Y	Child of 28 and 20	8
24	XXXVII	7	M	Y	Y//A	Y	Child of 28 and 20	8
25	XXXVIII	5	F	Y	Y//A	Y	Child of 28 and 20	8
26	XXXIX	3	F	Y	Y//A	Y	Child of 28 and 20	8
27	XL	1	M	Y	Y//A	Y	Child of 28 and 20	8
28	XXXIII	37	M	Y	Y	A	Son of 3, husband of 20	8
29	XXXII	18	F	Y	Y	A	Daughter of 3	8
30	XLIX	6	M	Y	Ar/Y//Y	Y	Child of 35 and 9	8

32	XCVII	2m.	M	Y	Ar/Y//Y	Y	Child of 35 and 9	7
33	XLI	3	F	Y	Y	C//A	Daughter of 16 and 51	6
34	XLII	4	M	Y	C//Y	Y	Son of 50 and 17	6
35	XLIV	31	M	Y	Ar//Y	Y	Married to 9	6
36	LXXXVII[3]	25	M	Y	Ar//Y	Y		6
37	LXXXVIII[3]	22	M	Y	Ar//Y	Y		6
38	XLV	20?	M	Y	Ar//Y	Y	Children of 51	6
39	XLVIII	20?	F	Y	Ar//Y	Y	Married to 43	6
40	XLVI	10	M	Y	Ar//Y	Y		6
41	XLVII	8	F	Y	Ar//Y	Y		6
42	LIII	1	F	Y	Ar/O//O	Ar/Y//Y	Daughter of 43 and 39	6
43	VI	47	M	Y	Ar//O	O	Husband of 39, father of 42	6
44	LIV	n.b.	F	Y	C?	Y//A	Daughter of 29	4
45	L	2	F	Y	C?	Y	Daughter of 9; wedlock. See also 10, 30–32.	4
46	XCI[3]	10	M	M?	C	Y	Child of 18	4
47	XCII[3]	6	F	M?	C	Y	Child of 18	4
48	XCIII[3]	4	M	M?	C	Y	Child of 18	4
49	LXXI	28?	M	Y	C	A	Father of 34	4
50	LXXII	28?	F	Y	C	A	Mother of 33	4
51	XLIII	51	M	Y	Ar	Y	Father of 35–41	4
52	LXXXIX[3]	20	M	Y	F	Y		4
53	XC[3]	18	F	Y	F	Y		4
54	LI	16	F	M–Y	E	Y		4
55	XCIV[3]	8	F	prob.W	E	Y	Cousins	4
56	XCV[3]	20	F	W	E	Y		4
57	LVII	29	F	C	S	Y//O(A?)	0	4
58	LV	27	F	C	S	Y//O(A?)		4
59	LVIII	22	F	C	S	Y//O(A?)	Sisters and	4
60	LIX	15	F	C	S	Y//O(A?)	brothers	4
61	LVI	12	M	C	S	Y//O(A?)		4
62	LX	5	M	C	C	S//Y/O(A?)	Son of 58	2
63	LII	8	M	Y	C?	Ar/Y//Y	Son of daughter of 51	3

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[1] Symbols: // separates father from mother of respective parent; / separates grandfather from grandmother; ? — ethnic affiliation undetermined; A — Alakaluf; Ar — Argentine; C — Chilean; E — English; F — French; M — Mestizo; O — Ona; S — Spanish; W — White; Y — Yámana.

[2] Number of Indian great-grandparents.

[3] Not seen by the writers.

5). This is true in an even higher degree for 2 other portrayed Yámana men (plate 5, nos. XXIII and XXVII) whose parents also were said to be Yámana. These 2 men apparently have no Indian traits and could be mistaken for Europeans. On the contrary, in the fifth male individual of this group, no. XXV, a boy of 10 years (plate 6), the Mongoloid features are unmistakable and even more pronounced than in any Ona we have met.

The 5 portrayed women of Yámana parents are all strikingly Mongoloid in facial type. A glance at nos. XXIV and XXX (Lipschutz et al., '46, plate 2), XXII, XXVI and XXVIII (plate 7) is convincing as to this.

There is scarcely any difference between these Yámana men and women and the remaining 9 persons who are of Yámana-Alakaluf extraction. The man no. XXXIII (plate 6), born from a Yámana father (plate 5, no. XXIX) and an Alakaluf mother, no longer alive, may have some Ona strain. Actually we were first informed that the mother was Ona and only subsequently heard the version about an Alakaluf mother. His features are much less Mongoloid than those of the Onas and the Yámana women already mentioned. On the contrary, his sister (plate 6, no. XXXII) is pronouncedly Mongoloid, and the same is true of his 7 fine children born of his Yámana wife (no. XXX, plate 8). One might meet with fundamentally identical faces in modern photographic news from progressive Asiatic autonomous republics of the Soviet Union, showing distinguished factory and agricultural workers, university students and intellectuals in general.

Nine of the 12 Yámanas sorted as mestizos belong to one family whose progenitors were an Argentine and a Yámana woman. They are of varied racial types; the man, no. XLIII (Lipschutz et al., '46, plate 5) is indistinguishable from White. His son (XLV) born of a Yámana mother is almost White; his daughter (plate 6, no. XLVIII) has features rather of a Yámana. The remaining 6 of these 9 Yámana mestizos are small children (XLVII) or grandchildren (XLIX, L, LII, LIII, XCVI) of no. XLIII; they are of varied racial types and

TABLE 3

Individuals of Alakaluf extraction.

SERIAL NUMBER	NUMERICAL DESIGNATION	AGE	SEX	ETHNIC[1] GROUP	ETHNIC GROUP OF PARENTS		FAMILY RELATIONSHIP	DEGREE OF INDIAN PARENTAGE[2]
					Father	Mother		
1	LXVIII	60?	F	A	A	A		8
2	LXIX	32?	F	A	A	A	Daughter of 1, mother of 13–17	8
3	LXII	39	M	A	A	A		8
4	LXI	32	M	A	A	A		8
5	LXV	26	F	A	A	A	Sister of 3	8
6	LXVI	?	F	A	A	A	Wife of 3	8
7	LXIII	17	M	A	A	A		8
8	LXVII	15?	F	A	A	A	Cousin of 7	8
9	LXIV	6	M	A	A	A	Son of 5	8
10	LXX	16?	M	[3]	C//A	A		6
11	LXXI	28	M	Y[4]	C	A		4
12	LXXII	28?	F	Y[4]	C	A	Sister of 11	4
13	LXXIII	16?	F	?	Ch–M	A	Children of 2	4
14	LXXIV	11?	F	?	Ch–M	A		4
15	LXXV	10?	M	?	Ch–M	A		4
16	LXXVI	8?	M	?	Ch–M	A		4
17	LXXVII	8mo.	M	?	Ch–M	A		4

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[1] Symbols: // separates father from mother of respective parents; A — Alakaluf; C — Chilean; Ch — Chilote; M — Mestizo; Y — Yámana.

[2] Number of Indian great-grandparents.

[3] Does not like to be an aborigine. See Lipschutz, et al., '46.

[4] Listed also in table 2 (nos. 49 and 50).

yet they are too young for their racial features to be characterized definitely. In any case, it is evident that these 9 individuals of the same parentage and the remaining 3 Yámana mestizos (XLI, XLII, LI) are — like the Ona mestizos — in no way different from Indian mestizo types in other South American populations.

PORTRAYAL OF ALAKALUFS (PLATES 9–13)

All the 9 portrayed Alakalufs insisted that they were of pure Alakaluf parentage. Seven of them came from Puerto Eden on Wellington Island, whereas the remaining 2 were from La Rinconada, a place on the shore of the Strait of Magellan.

The Alakalufs, men and women, are of low stature; their complexion is that of other southern Indians.

The 3 men (Lipschutz et al., '46, plate 3, no. LXI; plate 9, no. LXII and LXIII) and the boy no. LXIV seem less Mongoloid than Onas and Yámanas. Their eyes are less slit-like, cheek bones slightly less accentuated, lips larger and more fleshy. However, the hair in these 4 individuals is straight and very coarse. In the adults it grows also on the forehead and the temples. Hair is absent on the chest and the axillary region; the upper limit of the pubic hair is a straight line (plate 9). In these regards they are similar to other Fuegians, though, as already mentioned, their hair is much coarser. But their other features are certainly very different from those of Onas and Yámanas.

The 3 women from Puerto Eden sorted as Indians (Lipschutz et al., '46, plate 3, no. LXVI; plate 10, nos. LXV and LXVII) are entirely different from the 2 Alakaluf women from La Rinconada (plate 11, nos. LXVIII and LXIX). In the latter the Mongoloid character is more pronounced as to eyes, cheek bones and shape of face. The 2 Alakaluf women from La Rinconada, especially the younger one (LXIX), are nearer to the Yámana type than the 3 women from Puerto Eden. In view of the proximity of the 2 tribes, miscegenation between them is not out of the question.

As to the 8 Alakalufs sorted as mestizos, 5 are children of no. LXIX married to a ‘‘Chilote,’’ a mestizo from the island of Chiloé. They are not distinguishable from South American mestizos in general (plates 12 and 13). The features of an Alakaluf mestizo (Lipschutz et al., ’46, plate 4, no. LXX) met on the southern shore of Isla Grande show affinity to those of the Puerto Eden group. The mestizos nos. LXXI and LXXII (Lipschutz et al., ’46, plate 4) though said to be brother and sister, are both very different from each other: the man is Mongoloid whereas the woman is of the current Chilean mestizo type.

DISCUSSION

Our observations presented above and illustrated in the photographs show conclusively that the Fuegians, rather than being Australoid, are actually very similar to the Mongoloid Indians in general. This is true for all 5 of the portrayed Onas and for the majority of the 19 portrayed Yámanas sorted as Indians on the basis of their Fuegian descent. They have a complexion similar to that of many Indian groups; they have slit eyes, straight hair, high cheek bones and the distribution of body hair is similar to that of American Indians. The several Yámana men who fail to show American Mongoloid traits, resemble Whites. This is probably due to miscegenation. Moreover, they resemble the 26 individuals of Ona and Yámana extraction sorted as mestizos on account of known miscegenation of parents or grandparents with Whites. These Fuegian mestizos resemble Chilean mestizos in general.

The difference between Ona and Yámana Indians is consistent and should be evident to everyone who observes the Fuegians. But both have Mongoloid traits in the sense given above.

The features of the Alakaluf men and women from Puerto Eden sorted as Indians differ from those of Onas and Yámanas. They are certainly less Mongoloid than the Onas and the Yámanas. But the Alakaluf women from La Rinconada are similar to Yámana women. Whereas we feel ourselves on firm ground when referring to the Mongoloid traits of Onas and Yámanas, we are much less sure as to the Alakalufs and feel that they require further study.

SUMMARY

Photographs were made of 67 individuals of Ona, Yámana and Alakaluf extraction. Thirty-three of these individuals were sorted as Indians on the basis of their supposedly pure Fuegian descent. The remainder were classified as mestizos.

There is a remarkable difference between the features of the Ona of Patagonian origin on one side and the features of Yámana and Alakaluf on the other. But the features of both Ona and Yámana men and women are the familiar Mongoloid features of American Indians, such as dark straight hair, slit eyes, and high cheek bones.

The Ona and Yámana Indians who do not show Mongoloid traits resemble Whites, or mestizos between Fuegians and Whites.

The Ona and Yámana mestizos were identical in their features with Chilean mestizos in general.

The features of the few portrayed Alakaluf Indians were certainly less Mongoloid than those of the Ona and Yámana, though 2 Alakaluf Indian women were not much different from Yámana.

Our results on the prevalence of Mongoloid traits in pure strain Ona and Yámana do not support the concept of the Fuegians falling racially out of line with the multiform American Mongoloid Indians. As to the Alakaluf, no definite statement can be made.

Our thanks are due to Comm. Lt.-Col. Gustavo Luco and Dr. Juan Damiánovic, Sanitary Chief of the Province of Magellan, both members of the Mission; and to Dr. Luis Robin, of the Musée de l'Homme de Paris, who collaborated with us in our trip to the Isla Grande (Onas) and to La Rinconada (Alakalufs).

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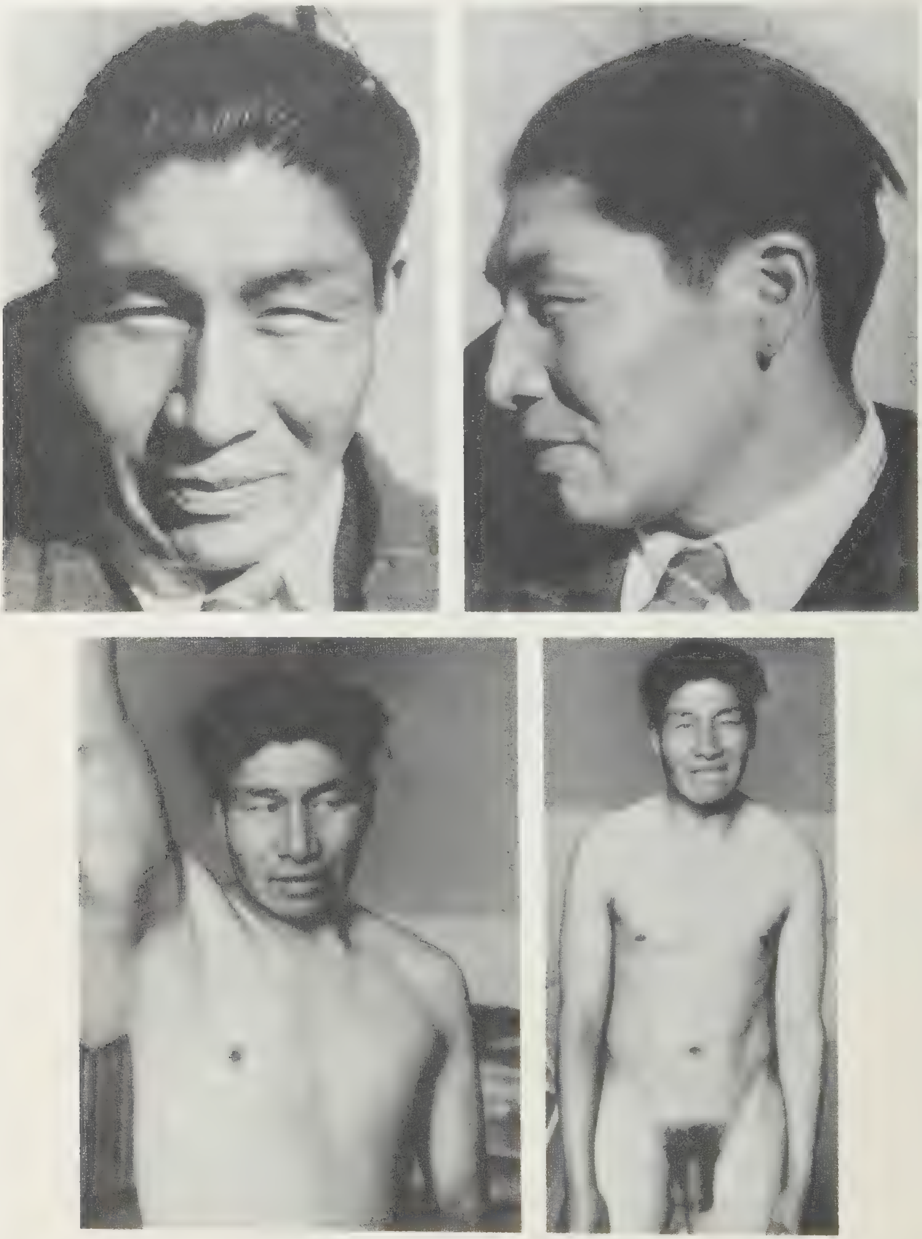
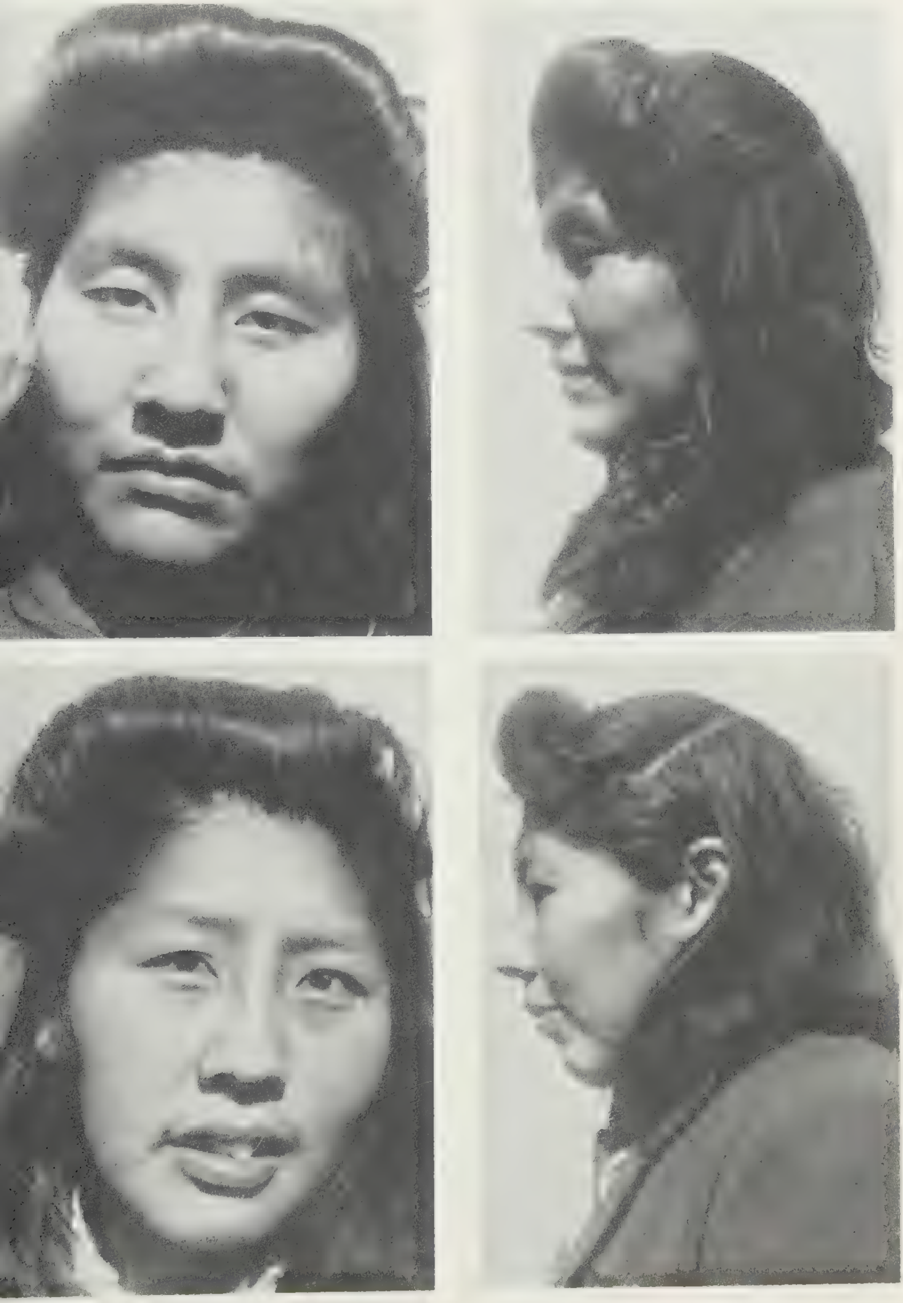
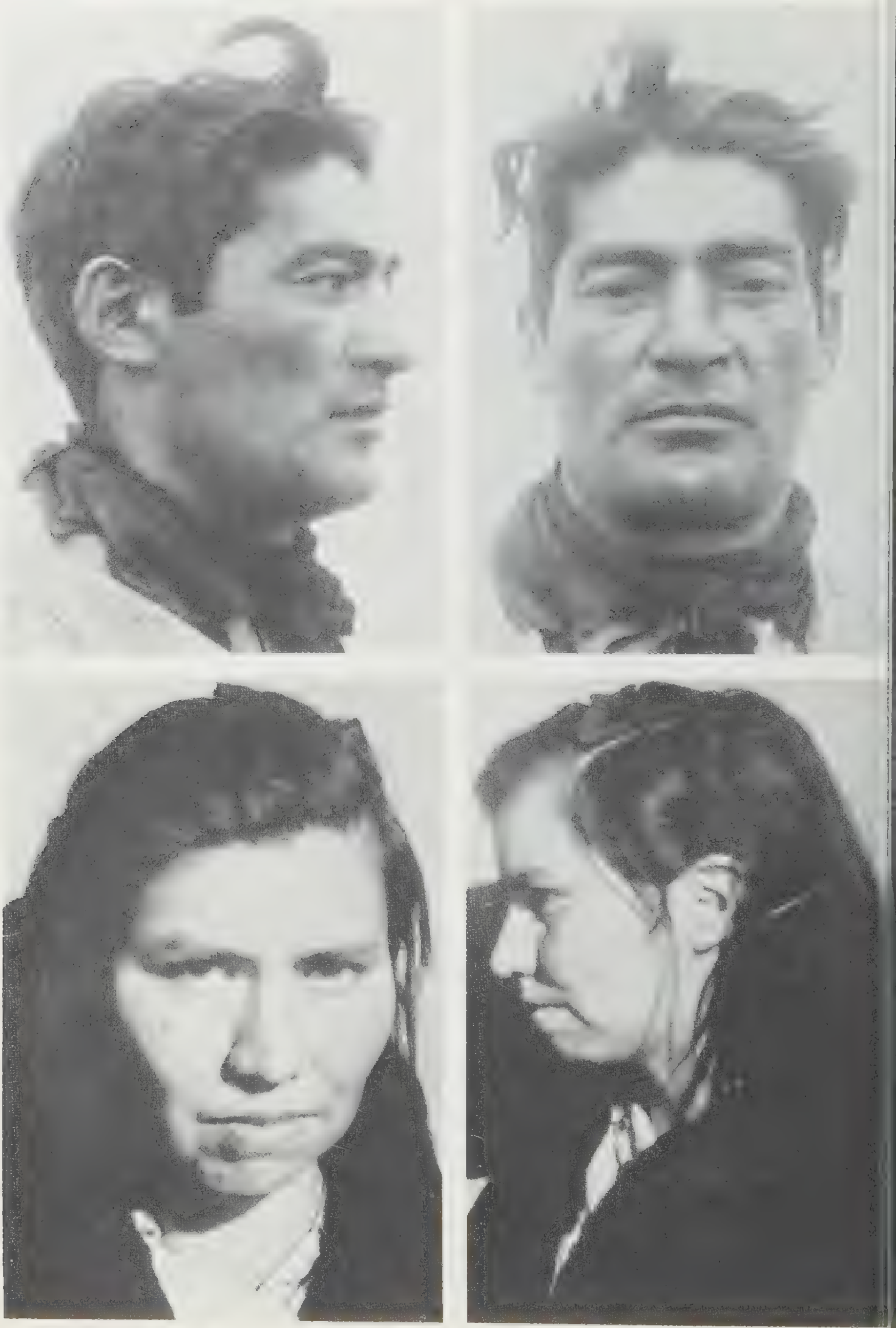


Ona (V). Misión Salesiana, Río Grande. 31 years old. Both parents were Ona. See also plate 14; Lipschutz et al., '46, plate 1.



Above. Ona (II). Misión Salesiana, Río Grande. 24 years old. Both parents were Ona. Daughter of Ona I; see Lipschutz et al., '46, plate 1.

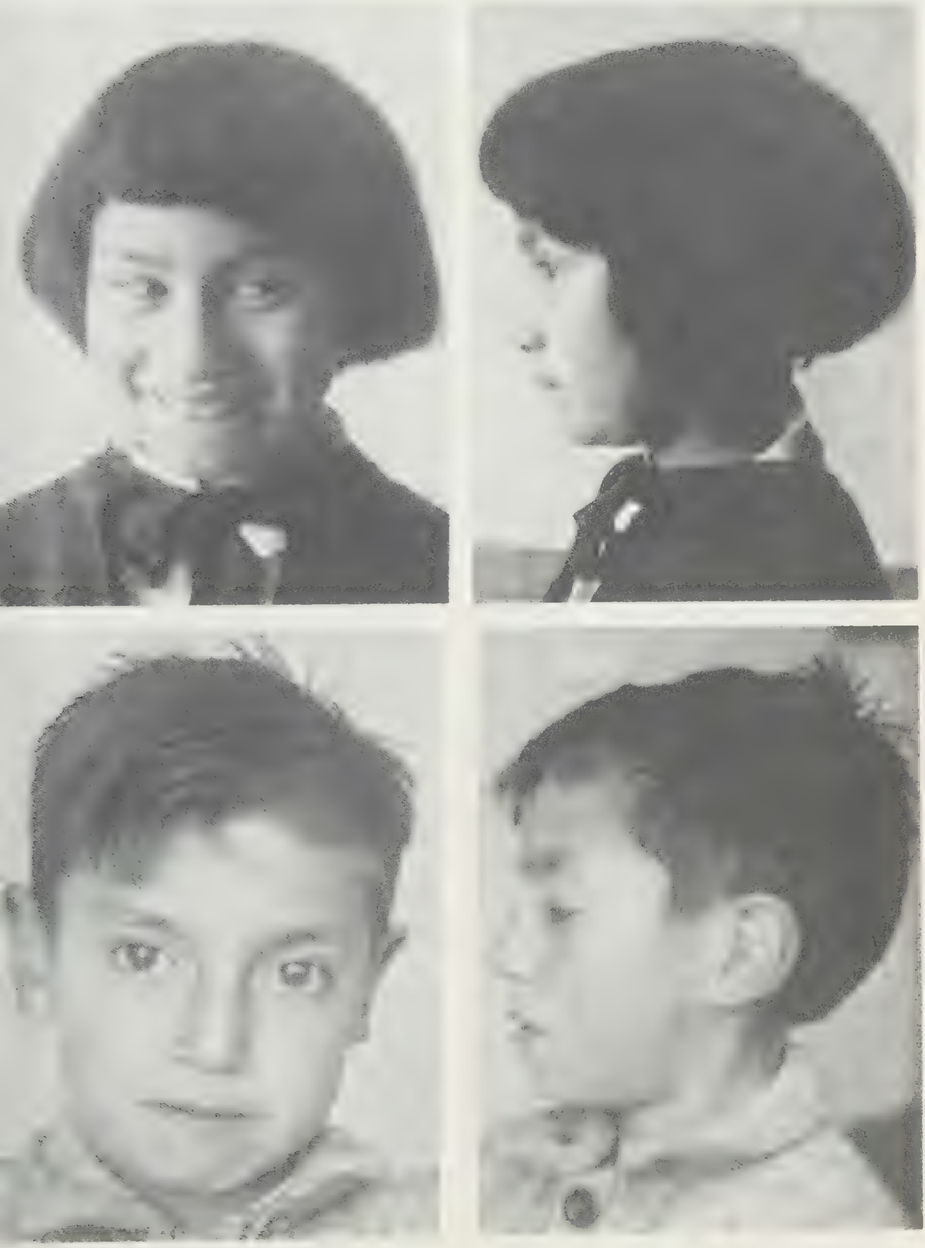
Below. Ona (III). Misión Salesiana. 20 years old. Both parents were Ona. Cousin of II.



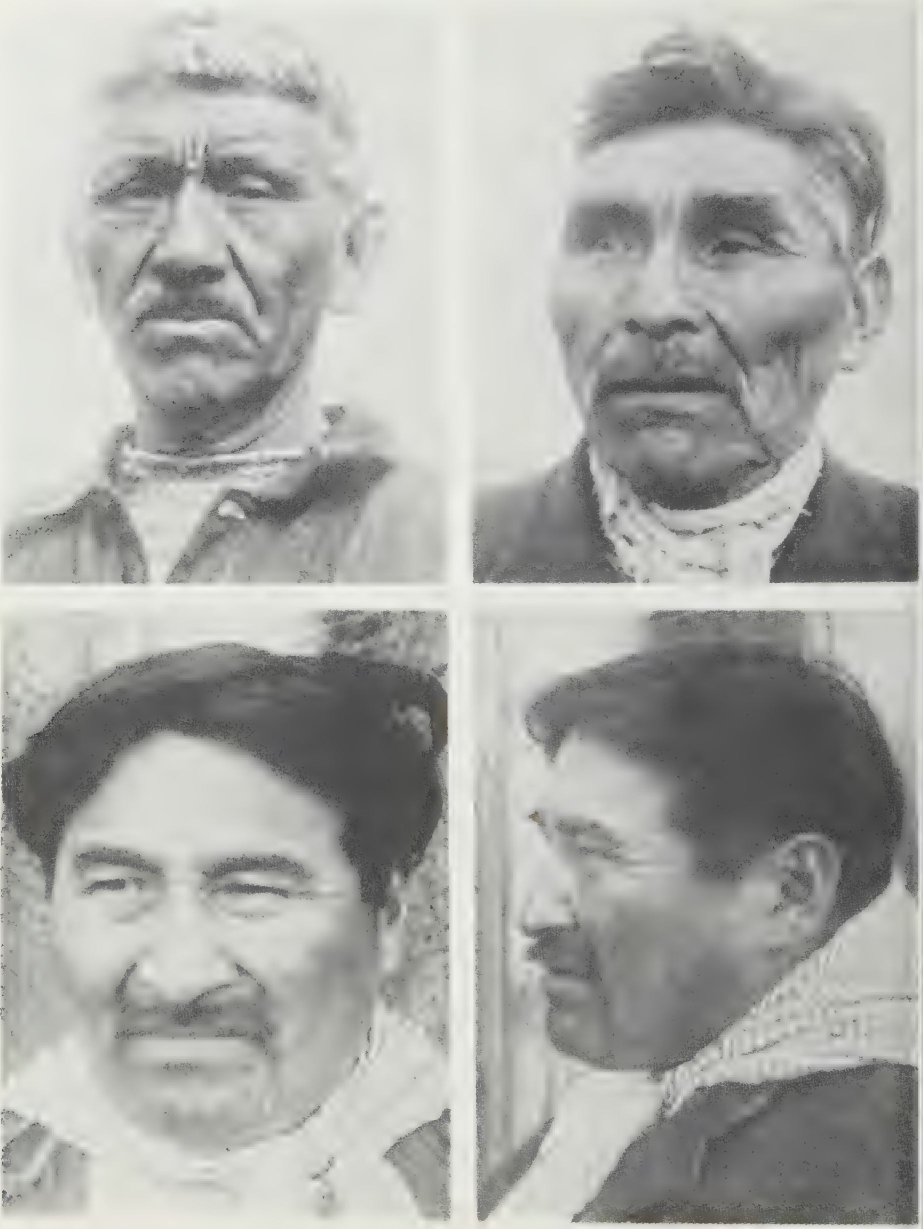
Above. Ona (VII). Puerto Harberton, southern shore of Isla Grande. 37 years old. Father White, mother Ona.

Below. Ona-Mestizo (IX). Misión Salesiana, Río Grande. 31 years old. Father Chilean, mother Ona.

PLATE 4



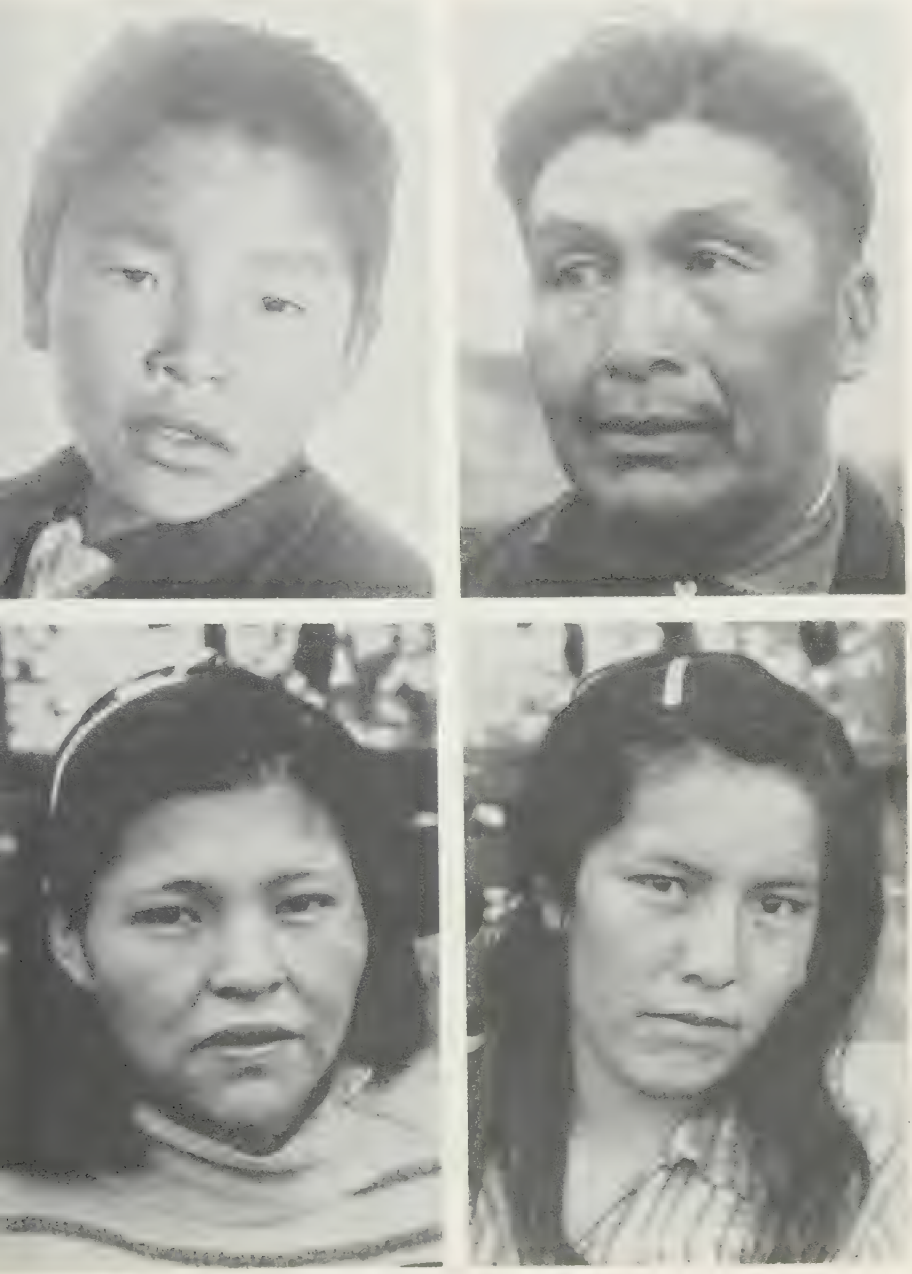
Two Ona-Mestizos (XVIII and XX). Misión Salesiana, Río Grande. The boy (XX), 11 years old, is the son of IX (plate 3).



Above left. Yámana (XXIII), official chief of the tribe. Living in Puerto Navarino, Island of Navarino. 55 years old. Both parents were Yámana.

Above right. Yámana (XXIX). Santa Rosa, Island of Navarino. 72 years old. Both parents were Yámana. Father of XXXII and XXXIII (plate 6).

Below. Yámana (XXVII). Puerto Róbalo, Island of Navarino. 48 years old. Both parents were Yámana. Father of XXVI (plate 7).

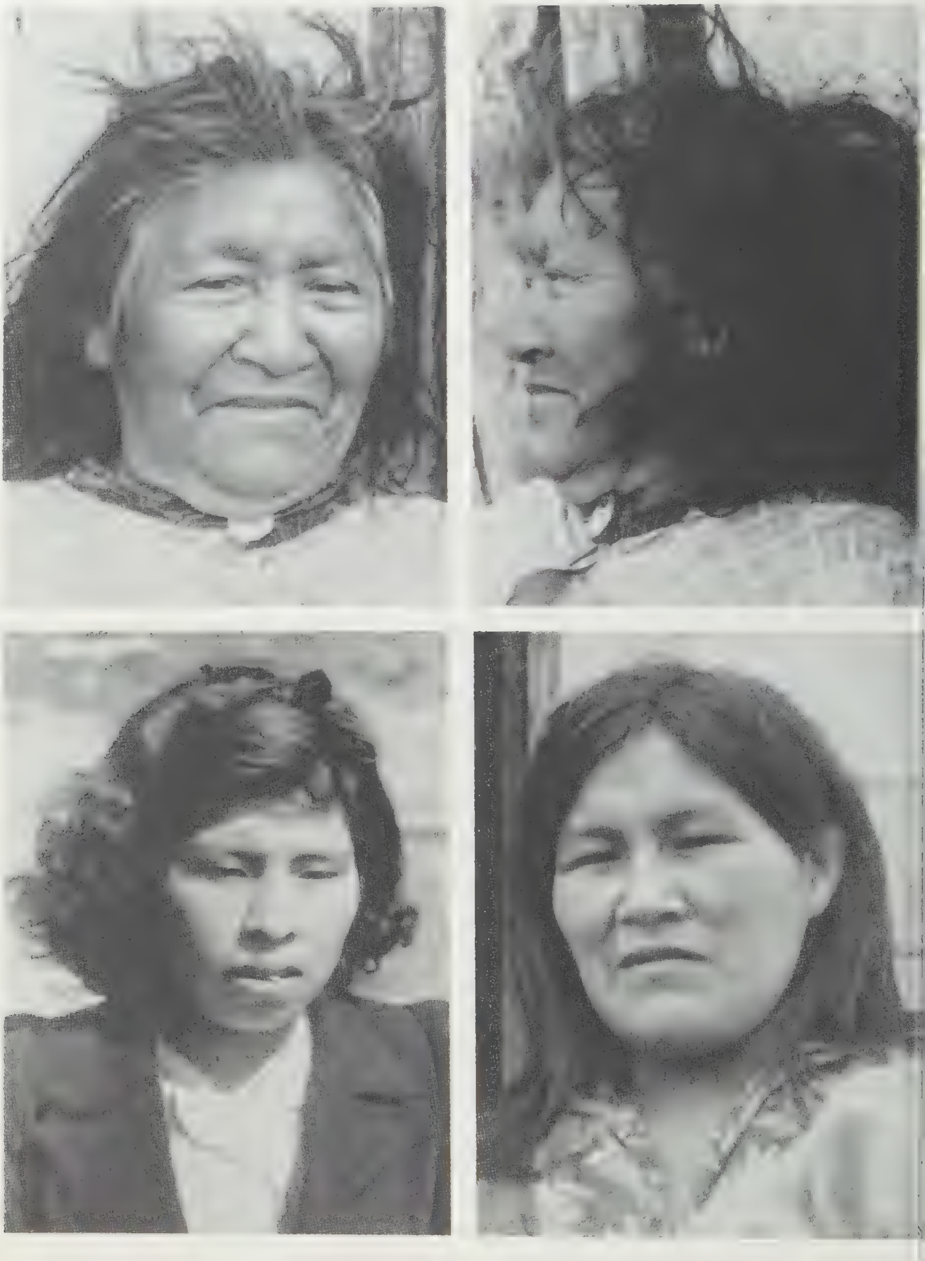


Above left. Yámana (XXV). Puerto Navarino. 10 years old. Both parents were Yámana.

Above right. Yámana (XXXIII). Santa Rosa, Island Navarino. 37 years old. Father ámana (XXIX, plate 5), mother Alakaluf.

Below left. Yámana (XXXII). Santa Rosa, Island Navarino. 18 years old. Sister of XXIII.

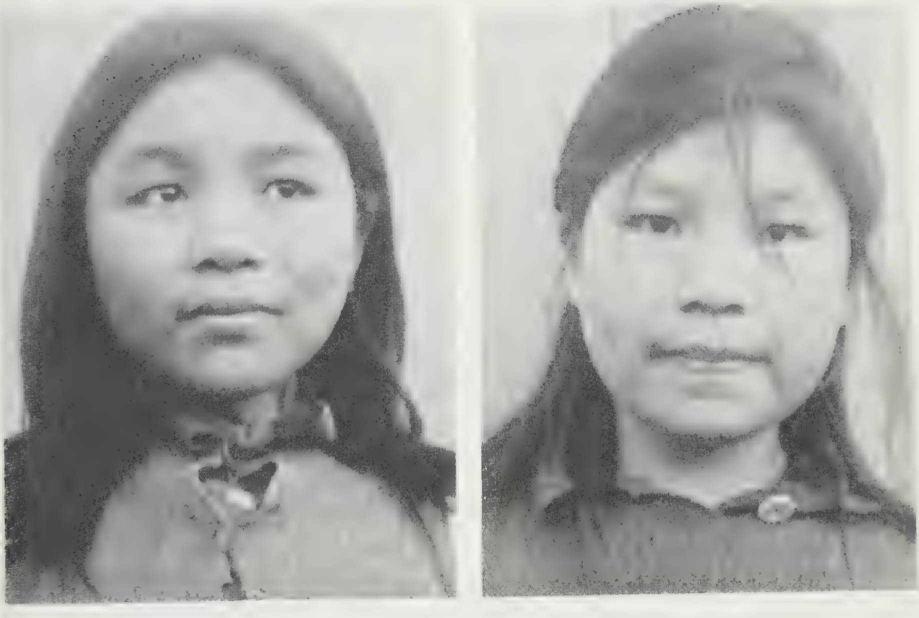
Below right. Yámana-Mestizo (XLVIII). Puerto Róbalo, Island Navarino. 20 (?) years d; of Argentine-Yámana extraction (Father, XLIII; see Lipschutz et al., '46, plate 5).



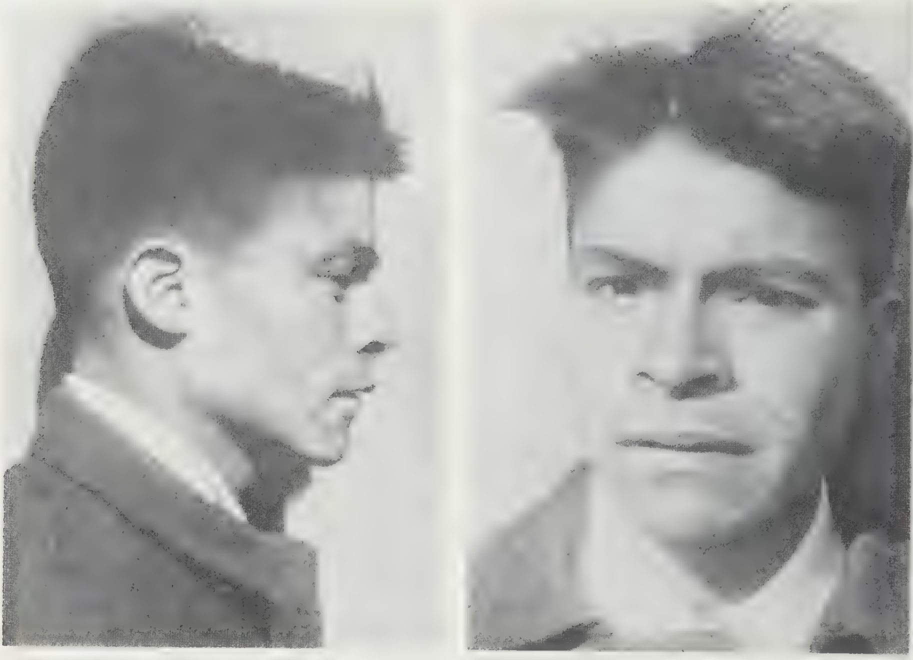
Above. Yámana (XXVIII). Puerto Róbalo, Island Navarino. 75 years old. Both parents were Yámana.

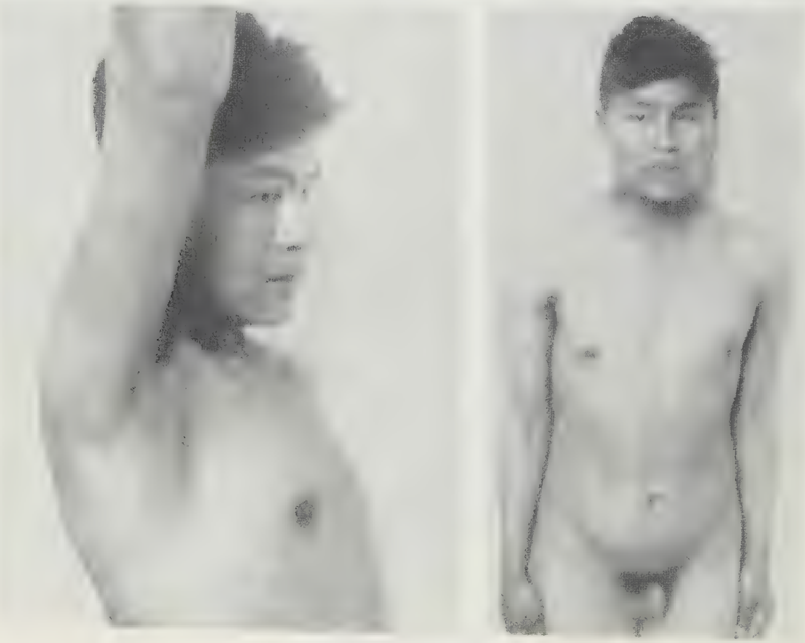
Below left. Yámana (XXII). Yendegaia, southern shore of Isla Grande. 21 years old. Both parents were Yámana. Sister of XXI (Lipschutz et al., '46, plate 2, above left).

Below right. Yámana (XXVI). Puerto Harberton, southern shore of Isla Grande. 28 years old. Both parents were Yámana. Daughter of XXVII (plate 5).



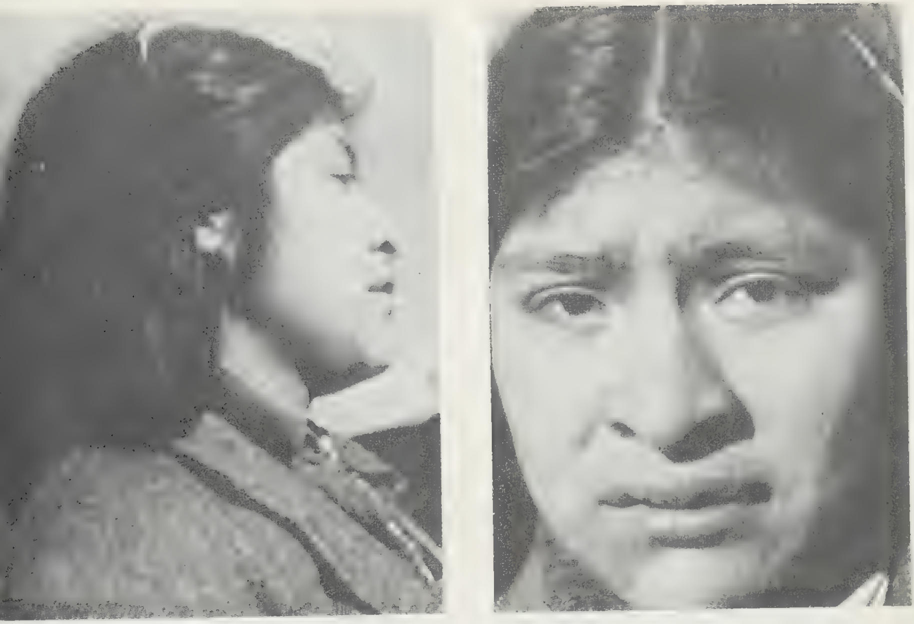
Five children of XXXIII (plate 6) and XXX (Lipschutz et al., '46, plate 2). Above left: 13 years old (XXXIV). Above right 11 years old (XXXV). Below: 9, 7 and 5 years old (XXXVI to XXXVIII).

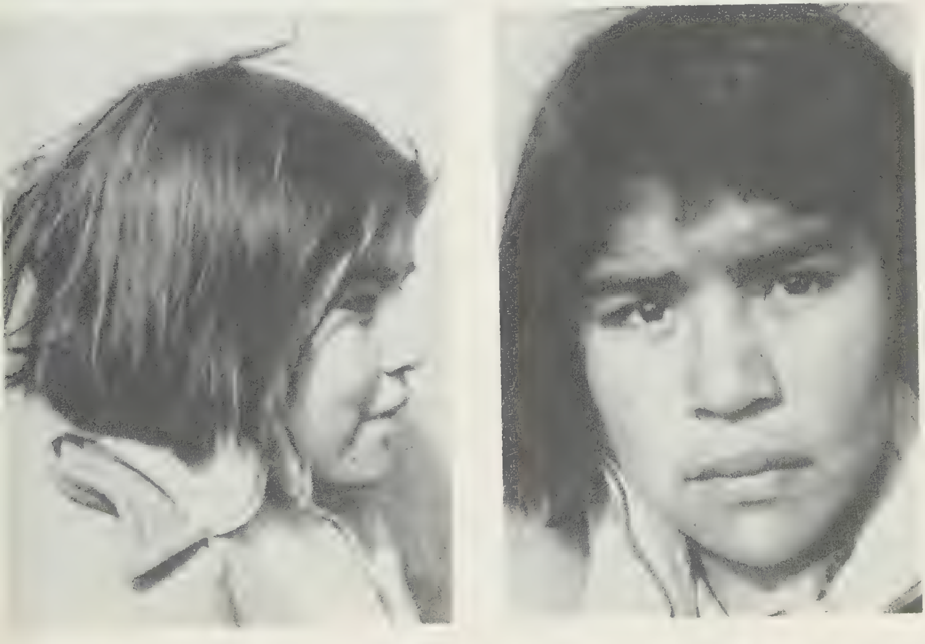




Above. Alakaluf (LXII). Puerto Eden, Island of Wellington. 39 years old. Both parents were Alakaluf.

Below. Alakaluf (LXIII). Puerto Eden, Island of Wellington. 17 years old. Both parents were Alakaluf (see also Lipschutz et al., '46, plate 3).

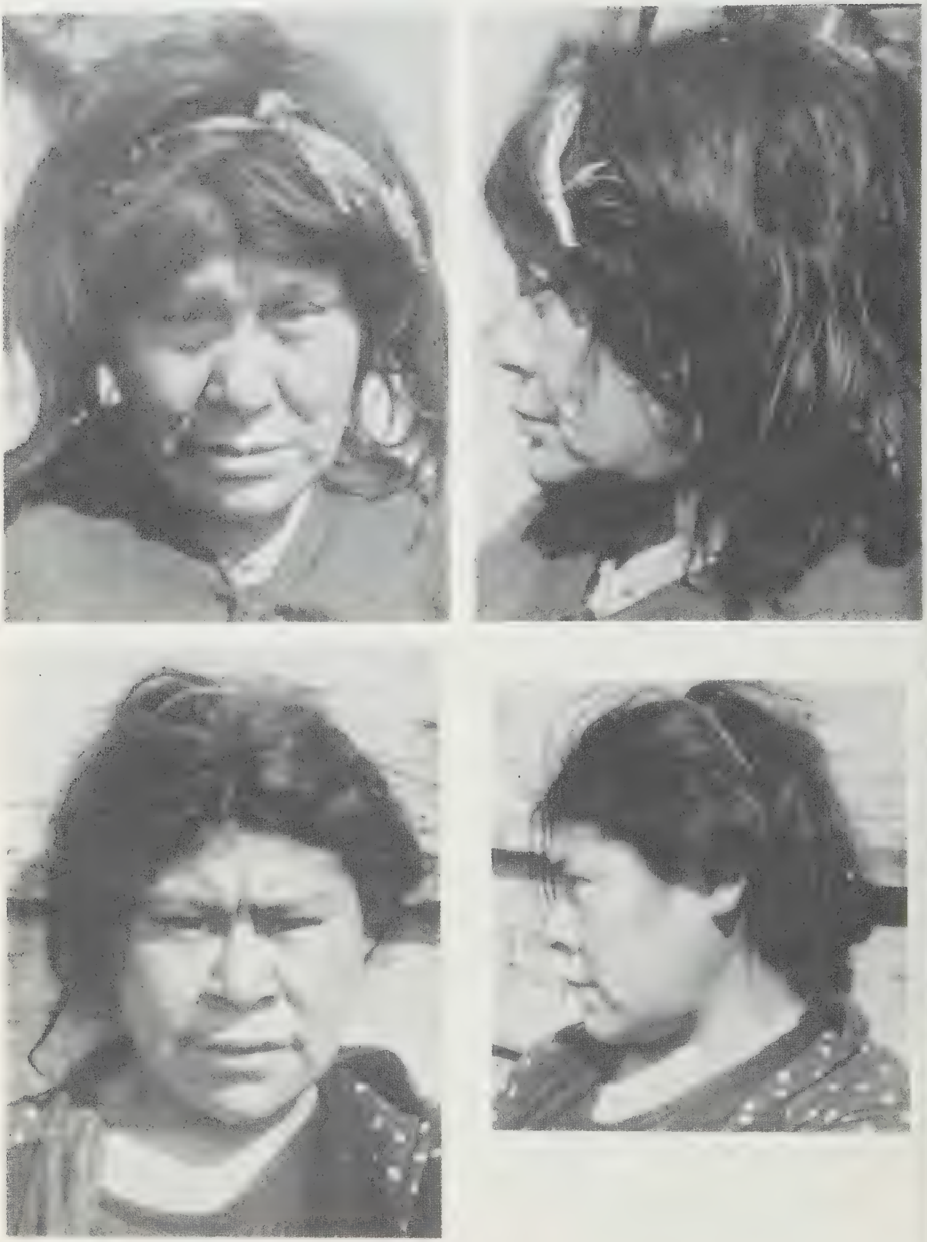




Above. Alakaluf (LXV). Puerto Eden, Island of Wellington. 26 years old. Both parents were Alakaluf.

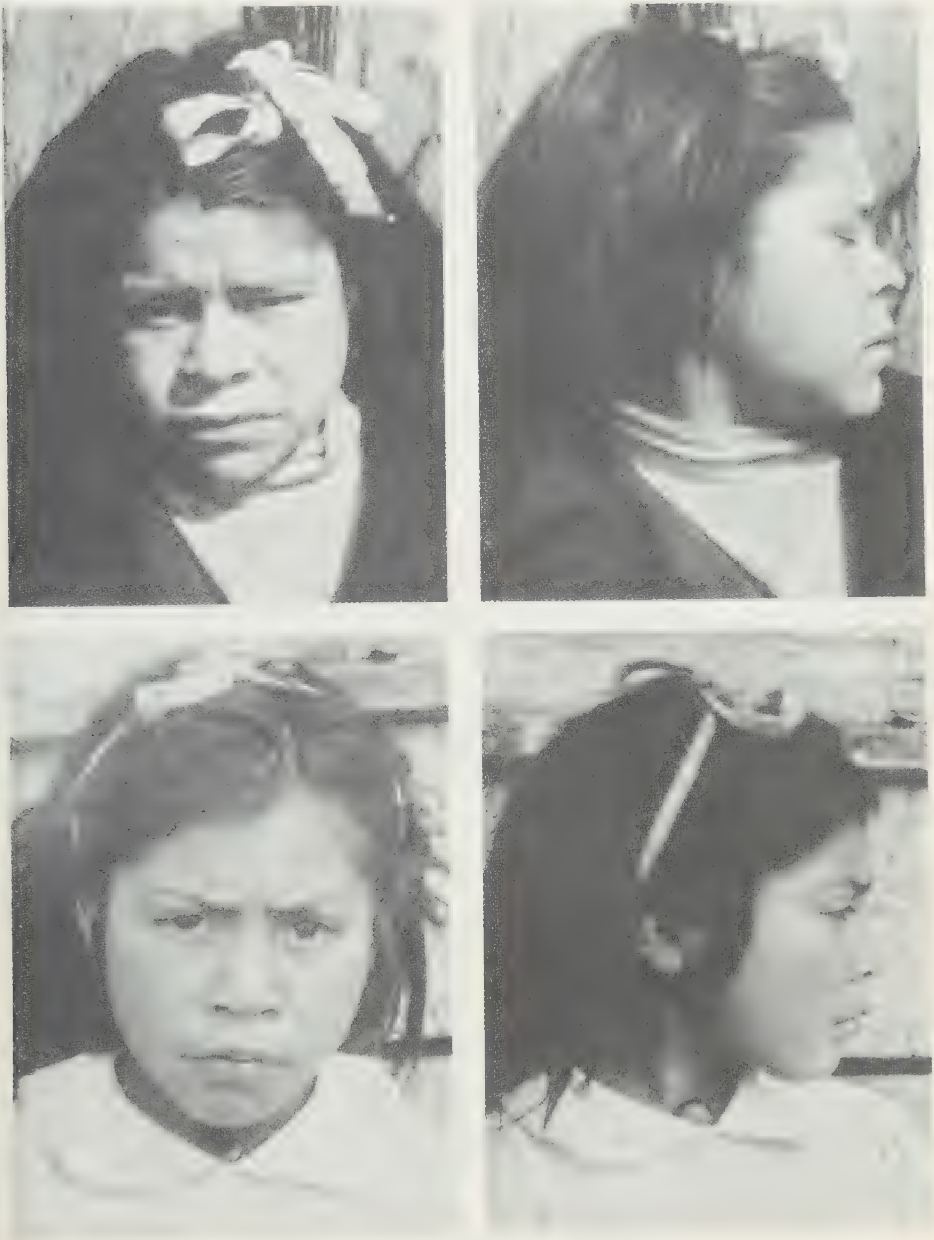
Below. Alakaluf (LXVII). Puerto Eden, Island of Wellington. 15 (?) years old. Both parents were Alakaluf.

For another Alakaluf woman see Lipschutz et al., '46, plate 3.



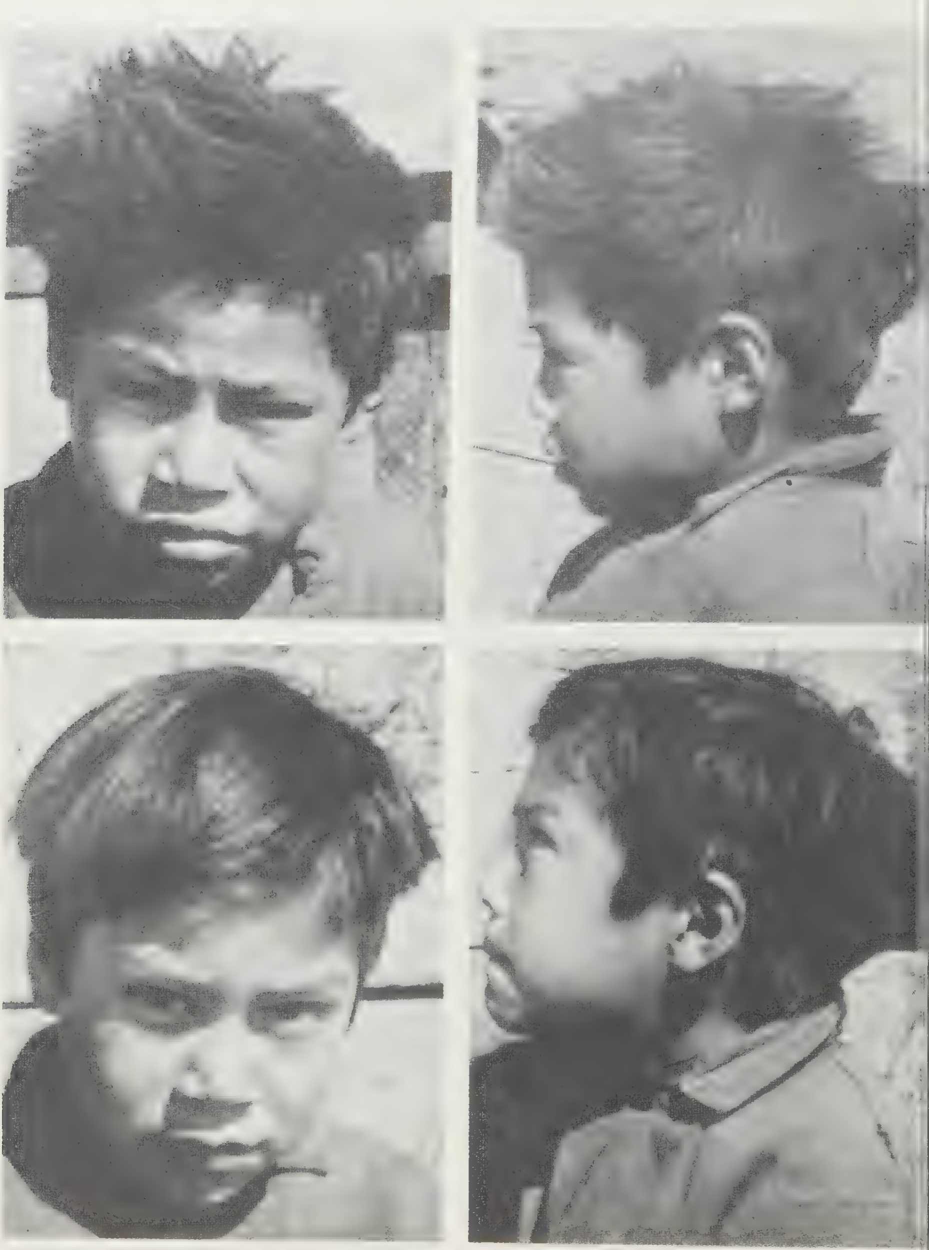
Above. Alakaluf (LXVIII). La Rinconada, Strait of Magellan. 60 (?) years old. Both parents were Alakaluf.

Below. Alakaluf (LXIX). La Rinconada, Strait of Magellan. 32 (?) years old. Both parents were Alakaluf. Daughter of LXVIII.



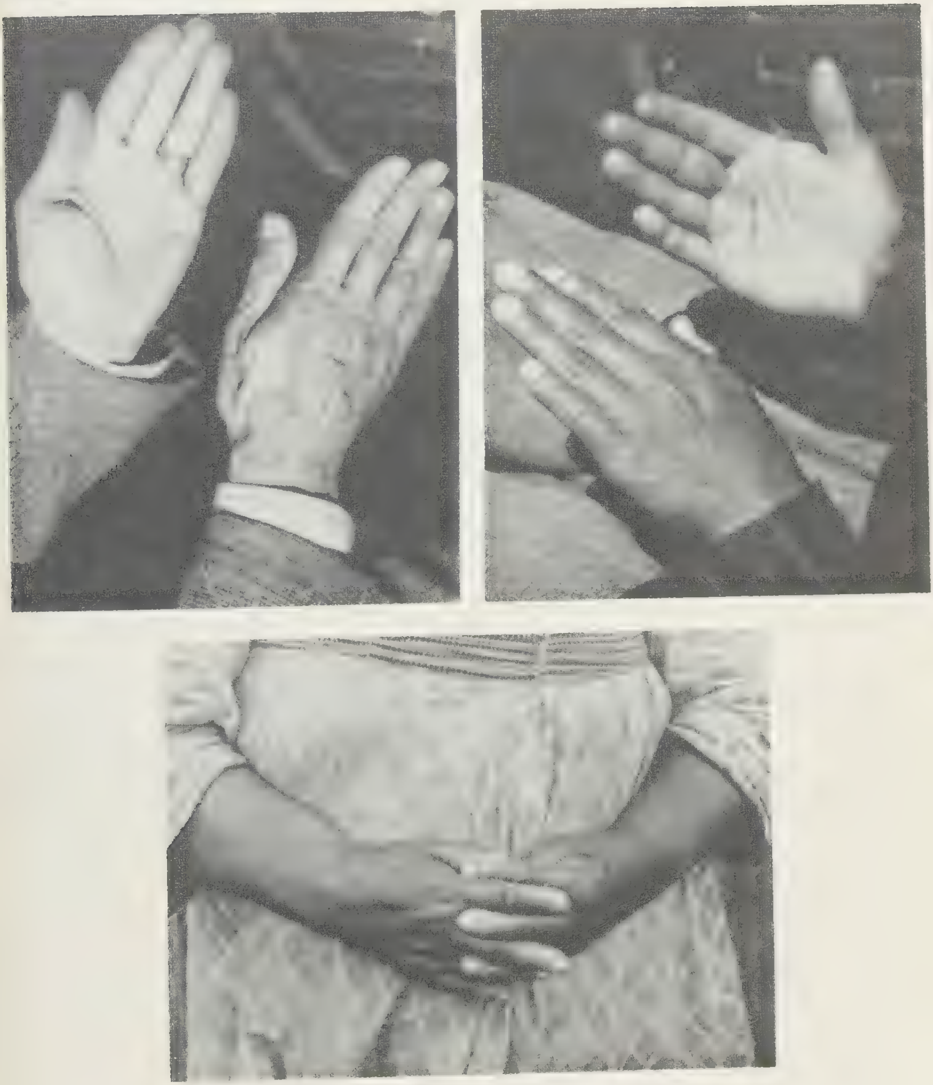
Above. Alakaluf-Mestizo (LXXIII). La Rinconada. 16 (?) years old. Daughter of LXIX (plate 11). Father "Chilote."

Below. Alakaluf-Mestizo (LXXIV). 11 (?) years old. Sister of LXXIII.



Above. Alakaluf-Mestizo (LXXV), brother of LXXIII and LXXIV (plate 12). 10 (?) years old.

Below. Alakaluf-Mestizo (LXXVI). 8 (?) years old. Brother of LXXIII to LXXV.



Above left. European.
Above right. Ona (I); see plate 1.
Below. Yámana (XXVIII); see plate 7.

Correction from Antonio Santiana.— In an extended correspondence between Dr. Antonio Santiana of Ecuador and the Editor regarding the "Bibliographic note" appearing on pp. 431–432 of the December, 1946, issue of this Journal the following points have developed.

a. Dr. Santiana was not aware of the Wistar's rule against duplicate and prior publication when he sent his manuscript to the Journal in 1945.

b. Although invited later that year by Dr. Lipschutz to participate in the Chilean Mission for the Study of the Fuegian Indian, Dr. Santiana denies that he was a "personal guest" of Dr. Lipschutz. His expenses were paid by the Universidad Central of Quito and the Casa de la Cultura Ecuatoriana.

c. While the Mission was in the field the personal relations between Drs. Lipschutz and Santiana deteriorated and the latter separated from the Mission after giving up his records.

d. In the "leaflet" dated March 12, 1946, the hearsay contents of which Dr. Lipschutz reported to the Editor, Dr. Santiana did not declare that he would write independently about the work in which he took part, nor did he ridicule the work of the other members of the Mission.

e. Dr. Santiana contends that the head of a scientific mission has no right to take possession of the data which other members of the mission have obtained through their technical and scientific knowledge.

f. He feels that there is no reason why the Universidad Central of Quito should not publish independently the work of one of its staff members.

(A review of the conflicting blood group data on the Fuegians is scheduled to appear in a forthcoming number of the Boletín Bibliográfico de Antropología Americana, Mexico.)

THE EFFECTS OF PARTIAL STARVATION ON SOMATOTYPE:

AN ANALYSIS OF MATERIAL FROM THE MINNESOTA STARVATION EXPERIMENT [1]

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ONE TEXT FIGURE AND FOUR PLATES

The present report covers but one aspect of a study of partial starvation. Its purpose is to indicate the effects of nutritional deprivation on those criteria of body build which determine the somatotype and are frequently considered to be inherent.

Beginning in 1944 Dr. Ancel Keys and his co-workers at the University of Minnesota conducted an experiment in which 34 volunteer conscientious objectors were subjected to a European type of famine diet for 24 weeks (Keys, '46). On this regimen the average weight loss was 24%. Measurements taken at the time demonstrated a tendency to decrease in every respect measured, even stature. Standardized nude photographs were taken both before and after the partial starvation period, and Dr. Keys has very kindly made a set of prints available to the present author for the purposes of this study.

In his work on the varieties of human physique, Dr. William H. Sheldon ('40) describes the methods of somatotyping. This constitutional typology consists in the recognition of 3 ''components'' of physique which he calls endomorphy, mesomorphy, and ectomorphy. By endomorphy he means an appearance of soft roundness and dominances of the digestive viscera. By mesomorphy he means relative predominance of muscle, bone and connective tissue. By ectomorphy he means linearity and fragility. In proportion to his mass the ectomorph has the greatest surface area and hence the relatively greatest sensory exposure.

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[1] This experiment was conducted by Drs. Ancel Keys, Austin Henschel, Olaf Mickelsen, Henry Longstreet Taylor, and Josef Brozek. Sponsorship is indicated in papers by Keys, et al., and by Henschel, et al., in the American Journal of Physiology, July 1947. Dr. Brozek made systematic anthropometric measurements on the subjects and supervised the photographic work.

An objective technique for determining somatotype is based on measurements from standardized photographs. When each of the 17 measurements described by Sheldon and his coworkers was applied to the photographs taken before and after partial starvation, it was seen that there was a decrease in every measurement for every individual with the exception of ankle, wrist, and head breadths (see table 1). In all 17 diameters there was a significant mean decrease. On the basis of these measurements there was a profound change in somatotype (Lasker, '47). Endomorphy and mesomorphy decreased, and ectomorphy increased. The extent of the change in type was marked, the mean change in endomorphy being a decrease of 49%, in mesomorphy a decrease of 43%, and in ectomorphy an increase of 77%. These differences are greater than those frequently interpreted to be of significance in differentiating series of people in respect to susceptibility to particular diseases or in respect to temperament. To the extent, therefore, that partial starvation, or even less severe nutritional deprivation, may be a disturbing factor in supposedly random samples, there is serious risk of misinterpretation. In fact, from the point of view of a study such as this, it may even be said that in a sense this method of somatotyping serves better as a measure of nutritional status than as a measure of inherent tendencies to specific constitutional types.

However, as it had been stated that the starved individual does not look exactly like a ''habitual'' ectomorph, it seemed desirable to apply other, so-called ''observational,'' criteria of somatotyping to the same material. Dr. James M. Andrews

TABLE 1

Changes in dimensions (taken as ratios of stature) of 32 males before and after partial starvation. Measurements made on photographs.

	NO.	CONTROL		24-WEEK STARVATION		CHANGE		
		Mean	Range	Mean	Range	Mean	Range	% Mean
1. Upper facial breadth	32	9.07	(8.4, 10.0)	8.72	(8.0, 9.7)	—0.35	(+0.20, —1.19)	—3.86
2. Lower facial breadth	32	7.51	(6.9, 8.2)	7.16	(6.6, 7.7)	—0.35	(0, —0.76)	—4.66
3. Neck depth	24	6.24	(5.7, 6.8)	5.92	(5.4, 6.5)	—0.32	(—0.01, —0.74)	—5.13
4. Neck breadth	32	6.63	(5.9, 7.5)	5.79	(5.4, 6.4)	—0.84	(—0.55, —1.32)	—12.67
5. Upper trunk breadth	32	18.99	(15.5, 20.8)	17.27	(15.2, 18.8)	—1.72	(—0.28, —3.61)	—9.06
6. Upper trunk depth	31	11.72	(10.4, 13.0)	10.82	(9.9, 11.8)	—0.90	(—0.08, —1.70)	—7.68
7. Waist breadth	32	15.06	(12.8, 16.7)	13.28	(12.0, 14.6)	—1.77	(—0.43, —2.64)	—11.75
8. Upper arm thickness	31	6.93	(5.7, 8.3)	5.07	(3.9, 6.2)	—1.87	(—1.16, —2.92)	—26.98
9. Forearm thickness	31	5.88	(5.3, 6.4)	5.16	(4.6, 5.7)	—0.72	(—0.29, —1.36)	—12.24
10. Wrist thickness	30	3.95	(3.5, 4.6)	3.67	(3.1, 4.1)	—0.28	(+0.26, —1.02)	—7.09
11. Waist depth	31	11.17	(9.5, 12.4)	9.70	(8.8, 11.0)	—1.47	(—0.39, —2.49)	—13.16
12. Hip breadth	32	19.09	(16.4, 22.0)	18.03	(15.4, 19.7)	—1.06	(—0.22, —2.29)	—5.55
13. Pelvic depth	31	12.98	(11.2, 14.7)	11.04	(10.3, 11.8)	—1.94	(—0.74, —3.22)	—14.95
14. Upper thigh depth	31	10.29	(9.2, 11.5)	7.68	(7.0, 8.8)	—2.61	(—1.77, —3.56)	—25.36
15. Lower thigh depth	31	7.32	(6.6, 8.0)	6.44	(5.9, 7.1)	—0.87	(—0.20, —1.84)	—11.89
16. Calf breadth	32	6.58	(6.0, 7.2)	5.82	(5.3, 6.6)	—0.75	(—0.21, —1.25)	—11.40
17. Ankle breadth	32	3.30	(2.9, 3.7)	3.20	(2.7, 3.8)	—0.10	(+0.38, —0.38)	—3.03

very kindly submitted the photographs to 5 somatotypers working under his direction in Professor E. A. Hooton's laboratory at Harvard University. A preliminary examination, in which each set of photographs was somatotyped independently by at least 3 workers using the observational standards then tentatively being tried at Harvard, revealed that endomorphy decreased by 46%, mesomorphy decreased by 27%, and ectomorphy increased by 64%. The author of the present report has independently repeated this examination,

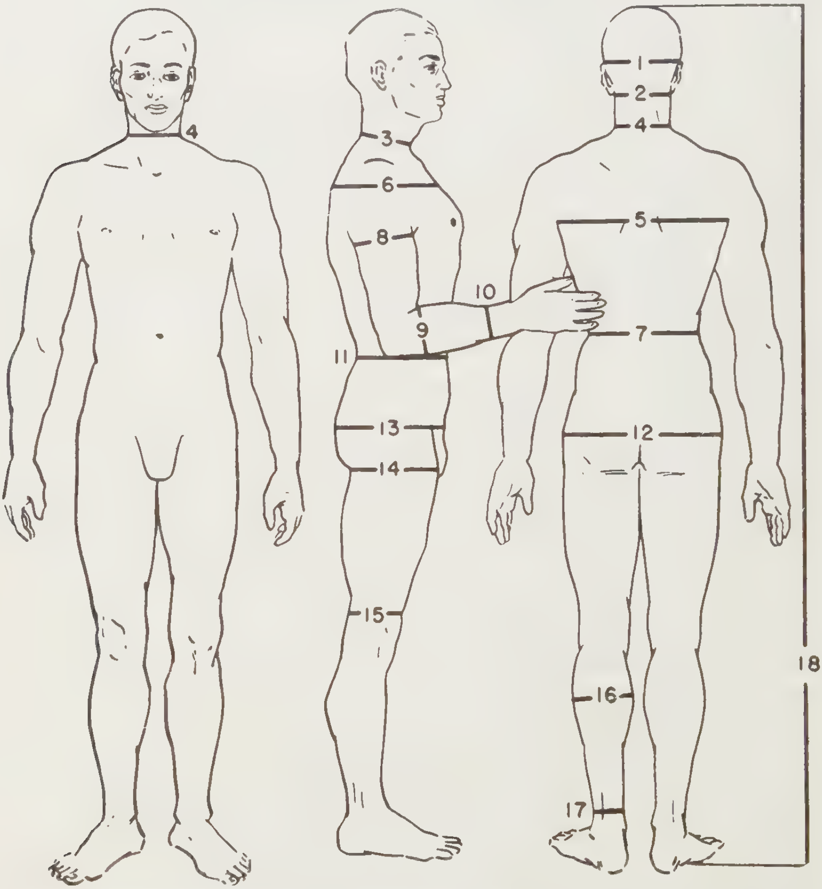

Fig. 1 Measurements taken on photographs. Measurements 1–17 were taken as a ratio of stature (18) and the mean dimensions are presented in table 1.

using the same method as described by Professor Hooton ('46).[1] This revealed a mean decrease of 49% in endomorphy, a decrease of 25% in mesomorphy, and an increase of 67% in ectomorphy. These changes are only slightly less marked than those derived from the measurements (see table 2).

TABLE 2

Mean ratings of somatotype components before and after partial starvation according to various techniques applied.

	FROM MEASUREMENTS [2]	FROM MEASUREMENTS [3]	FROM OBSERVATIONS [4]	FROM OBSERVATIONS [5]
Endomorphy				
Control mean	3.35	3.27	3.49	3.58
24-week starv. mean	1.71	1.71	1.87	1.81
Change mean	1.64	1.56	1.61	1.77
Change per cent	49.0	47.7	46.1	49.4
Change range	1, —4	2, —4	—1, —3	0, —3
Mesomorphy				
Control mean	3.74	3.92	3.94	3.77
24-week starv. mean	2.15	2.19	2.87	2.82
Change mean	1.60	1.73	1.06	0.95
Change per cent	42.8	44.1	26.9	25.2
Change range	3, —3	2, —4	0, —2	1, —2
Ectomorphy				
Control mean	3.32	3.32	3.52	3.06
24-week starv. mean	5.89	5.95	5.77	5.10
Change mean	2.57	2.63	2.25	2.04
Change per cent	77.4	79.2	63.9	66.7
Change range	3, —3	4, —3	3, 1	3, 1

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[1] All ratings are on a scale from 1 to 7. The methods suggested by Bullen and Hardy ('46) were also attempted and seemed to give results similar to those reported here for other rating methods.

[2] Following the method of Sheldon but excluding regions I and III, head and neck and arm.

[3] Also following Sheldon's method but including the $ht/\sqrt[3]{wt}$ index and neck diameters and rating all available measurements to be of equal diagnostic value.

[4] Preliminary report from Dr. James M. Andrews. Each set of photographs was examined by 3 or 4 of the 5 somatotypers who participated, and the means of the means for each case are presented here.

[5] Observations by the author of the present work using the same techniques as in the previous column.

Though all individuals changed somatotype, the degree of change varied from individual to individual. Mesomorphy was unchanged in several cases, endomorphy was unchanged in one case, but ectomorphy always showed an increase. In general, endomorphic individuals lost in endomorphy, mesomorphic individuals lost in mesomorphy, and ectomorphic individuals changed but little. The extent to which this is true is indicated by the extremely high correlation between the degree of change in a component during partial starvation and the level of that component at the outset. The respective product-moment correlations for endomorphy, mesomorphy, and ectomorphy are 0.88, 0.83, and 0.81. These figures may be compared with the correlation between loss of weight and initial weight or that of reduction in thigh circumference with initial thigh circumference: 0.76 in both instances.

As no individual, by any standard applied, failed to change in somatotype, the question arises whether all criteria of typing are equally subject to modification by partial starvation. Actually, all parts of the body are affected — but not to the same degree. In somatotyping it is customary to divide the body into five regions: I. head and neck, II. thoracic trunk, III. arms, shoulders, and hands, IV. abdominal trunk, and V. legs and feet. Of these regions the head had been blocked out in the photographs of the present series. For the rest of the body, both the preliminary report from the Harvard anthropometric laboratory and the author's own examinations concur in noting the greatest decrease in endomorphy in the arm, shoulders, and hands, the greatest decrease in mesomorphy in the abdominal trunk, the greatest increase in ectomorphy in the thoracic trunk, and the least change in all three components in the legs and feet. However, these differences are not great, and the variability in degree of change is more notable in respect to individual traits than in respect to regions of the body.

A description of the changes attendant on partial starvation couched in terms of the characteristics which are of significance to somatotype will indicate how varied the effects on somatotype may be. These observations were made on the basis of the photographic material.

During partial starvation the neck becomes less smooth and less cylindrical, especially in individuals with well-developed musculature. The trapezius and sternocleidomastoid muscles become more prominent but narrower, and there is less pyramiding of the latter. The spines of the cervical vertebrae and the prominence of the thyroid cartilage become more protrusive, and the transverse diameter decreases relatively more than does the anteroposterior diameter of the neck. The decrease in the diameters of the neck, together with the loss of superficial tissues beneath the mandible and along the superior border of the trapezius muscle, makes the neck ordinarily appear somewhat longer. Sometimes there seems to be a slight increase in forward inclination of the neck.

The degree of drop of the sternal end of the clavicle is little affected by partial starvation. On the other hand, any softness of the clavicular outline disappears, and the greater prominence of the clavicle often makes it appear heavier. The clavicular hollow regularly increases in size.

In the back, the smoothness tends to decrease, especially in those individuals who start with considerable fatty padding. Muscularity also decreases, especially when it is dominant. The spines of the vertebrae and the bony landmarks of the scapulae become much more prominent. In all cases the scapula become winged. All breadths of the back decrease, particularly at the base of the thorax, and in some individuals the taper tends to increase.

In lateral view the chest becomes shallower, flatter, and more vertical from nipple to clavicle in virtually all cases. The lower depth decreases more than the upper depth. The vital capacity decreases. If there is fatty development of the breast, it tends to disappear.

The abdomen always decreases more than the thorax; so the relative dominance of the latter increases. The thorax sometimes seems to lengthen because the lower ribs when imbedded in fat appears as part of the abdomen. The total trunk, however, usually seems to shorten. The subcostal angle appears to narrow as the lower costal cartilages become more visible. It is impossible to assess the angle of the ribs to the vertebral column or sternum without the use of x-ray pictures, but the angles probably change little though they become less faint, and the ribs stand out more prominently and appear heavier after partial starvation.

In the shoulder region softness of contour and fat blanketing are, of course, greatly reduced or lost. The bony prominence and squareness of the tip are enhanced by the atrophy of the deltoid muscle. The height of the bony shoulder probably changes little, but there is a decrease in breadth.

Rounding and "hamming" of the arm regularly decrease. The preponderance of the upper arm over the lower, and of the upper parts of both segments over the lower parts, is usually lost. The arm, and especially the forearm, hence appears relatively longer. The total bulk and strength of the deltoid, triceps, biceps, and other muscles decrease, though in individuals who had been fat the contours of some of the muscles become more distinct.

The wrists change less than almost any other part of the body. Nevertheless, here also the bones become somewhat more prominent, and the wrist becomes more square than round. The superficial veins become much more apparent.

Changes in the hands also were somewhat limited, but there was regularly a noticeable loss of soft tissues between the metacarpals and elsewhere. The hands thus become more bony and seemingly square, with more prominent knuckles and joints. The digits become slenderer and seem longer.

The abdomen, one of the major areas observed in somatotyping, changes drastically during partial starvation. There is regularly a loss in depth and breadth, proportionally greater in the former. There is always a marked reduction in the muscular relief, especially of the rectus muscle, and the loss of tonus may be great enough to cause a slumped appearance and protrusion of the lower part of the abdomen. In any case, the abdomen appears underdeveloped and, usually, flatter. Transverse folds, when present, tend to disappear. The waist always becomes markedly "pinched," narrower, lower, more distinct, and sharper.

The pelvis appears narrower, and any tendency to fat pads about the upper part of the pelvis disappears. Muscles become less prominent; and the muscular rippling above the inguinal ligament disappears, giving way to a limp and curved inguinal line. The anterior superior iliac spines become more prominent in every instance.

Changes in the actual spinal curvature are impossible to assess, as this cannot be seen in photographs. The profile of the back, as seen in the lateral views, changes considerably. The lumbar curve appears higher and flatter, while the thoracic curve appears sharper.

The tissue of the buttocks is greatly atrophied. Any "pneumatic fullness," roundness, or softness is lost, and the muscularity also decreases (though in fat individuals the lateral dimples posterior to the femoral heads become much more prominent). The buttocks become very flat and also thin from side to side.

As will be expected, fat on the upper thigh also is lost, and fullness, softness or muscularity give way to a thinner, stringier, bonier appearance. The proximal predominance is lost, and the outer curve becomes less prominent. The degree of approximation of the thighs when the heels are together is radically reduced as the legs become thinner.

The outer and inner curves of the calves decrease, the latter showing more change in muscular individuals. The transverse diameter of the calf tends to show greater reduction in size than does the antero-posterior diameter, but the legs always become thinner and more spindly.

The changes at the ankle are not great. Usually there is a slight decrease in fat and an increase in prominence of the bone, but in some instances the nutritional edema obscures this, and the angles become enlarged.

The feet also show relatively little change. If anything, the feet sometimes appear larger, less pudgy, longer and more slender after partial starvation.

In all, 171 observational criteria which could be applied to this series were mentioned in the works of Sheldon and his co-workers, Bullen and Hardy, and Hooton. Each set of pairs of photographs was examined with respect to each of these traits. There were only 22 (13%) — virtually all pertaining to wrists, hands, ankles, and feet — in which there is little tendency to change. Only 19 of 140 traits listed by Hooton, 9 of 107 traits listed by Bullen and Hardy, and 7 of 79 traits listed by Sheldon et al. fall into this class. In an additional 16 traits the change is probably more apparent than real. By the use of improved standards these features might be appraised or measured. Thus length of the limbs appears to increase only because of the great reduction in all other dimensions.

Of the 133 remaining traits many were altered profoundly — often in every individual. Thus winged scapulae, which are considered a sign of ectomorphy, are a constant sign of partial starvation. Fullness of the buttocks is considered a sign of endomorphy, but the buttocks are regularly greatly reduced during partial starvation. In most cases the changes result from loss of fat. An example is the decrease in the pseudo-development of the breast in males — a sign of endomorphy. Many other traits are equally affected by loss of muscle and fat, as for instance the decrease in the endomorphic sign of the preponderance of the upper arm over the lower arm. Still other traits are affected primarily by loss of muscular tissue; thus many signs of mesomorphy — such as "ruggedness of the deltoid" — are regularly reduced. Still other traits change because of the increasing prominence of bone. An instance of this is the increasing incidence of "prominence of the ribs."

Virtually all the observations which are least affected by partial starvation in adulthood pertain to the shapes of bony parts, and it might be possible with the use of x-ray techniques or other osteometric methods to devise a body-build typology based on such bone traits. However, one would still need to take into account environmental factors which might affect the shapes of bones during the developmental period.

In any case, most of the criteria of somatotype are profoundly affected by adequacy of diet. The corollary follows that psychological and medical studies using somatotype as a measure of that aspect of the constitution which is inheritable will not be valid unless environmental factors are more rigorously controlled than has been the usual practice heretofore.

SUMMARY

1. Thirty-four volunteers were limited to a European type of diet for 24 weeks. During this period they lost an average of 24% of their body weight.

2. Somatotyping techniques have been applied to photographs taken at the beginning and end of the period.

3. Every individual shows a noticeable change in somatotype, and the majority of traits are shown to change in most of the individuals.

4. All the measurements used in somatotyping show a tendency to decrease, most of them in every individual.

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PLATE 1

EXPLANATION OF FIGURES

Below. After 24 weeks partial starvation. Somatotype 2 3 5.
Above. Control. Somatotype 3 4 4.

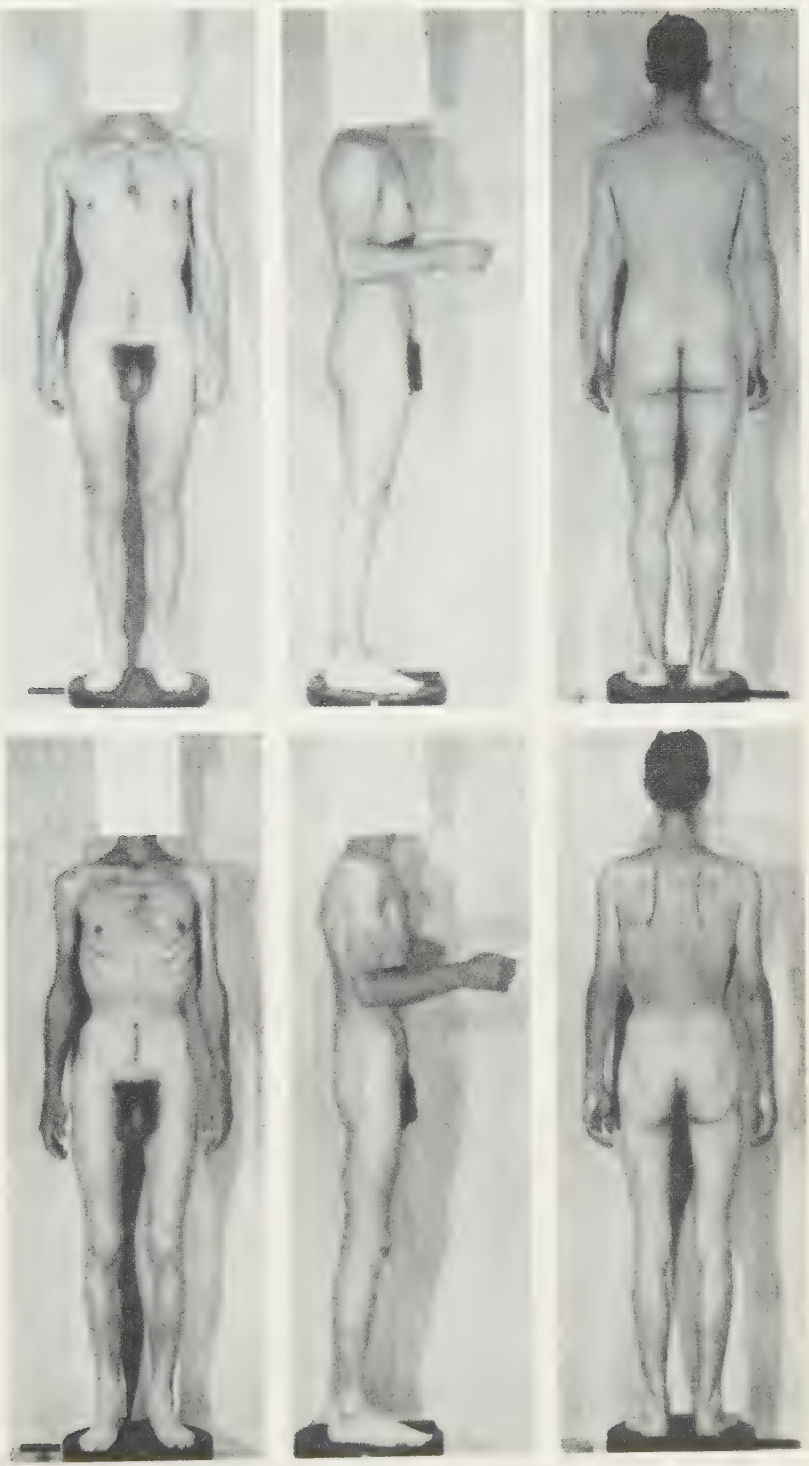


PLATE 2

EXPLANATION OF FIGURES

Above. Control. Somatotype 6 2 2.
Below. After 24 weeks partial starvation. Somatotype 3 2 4.

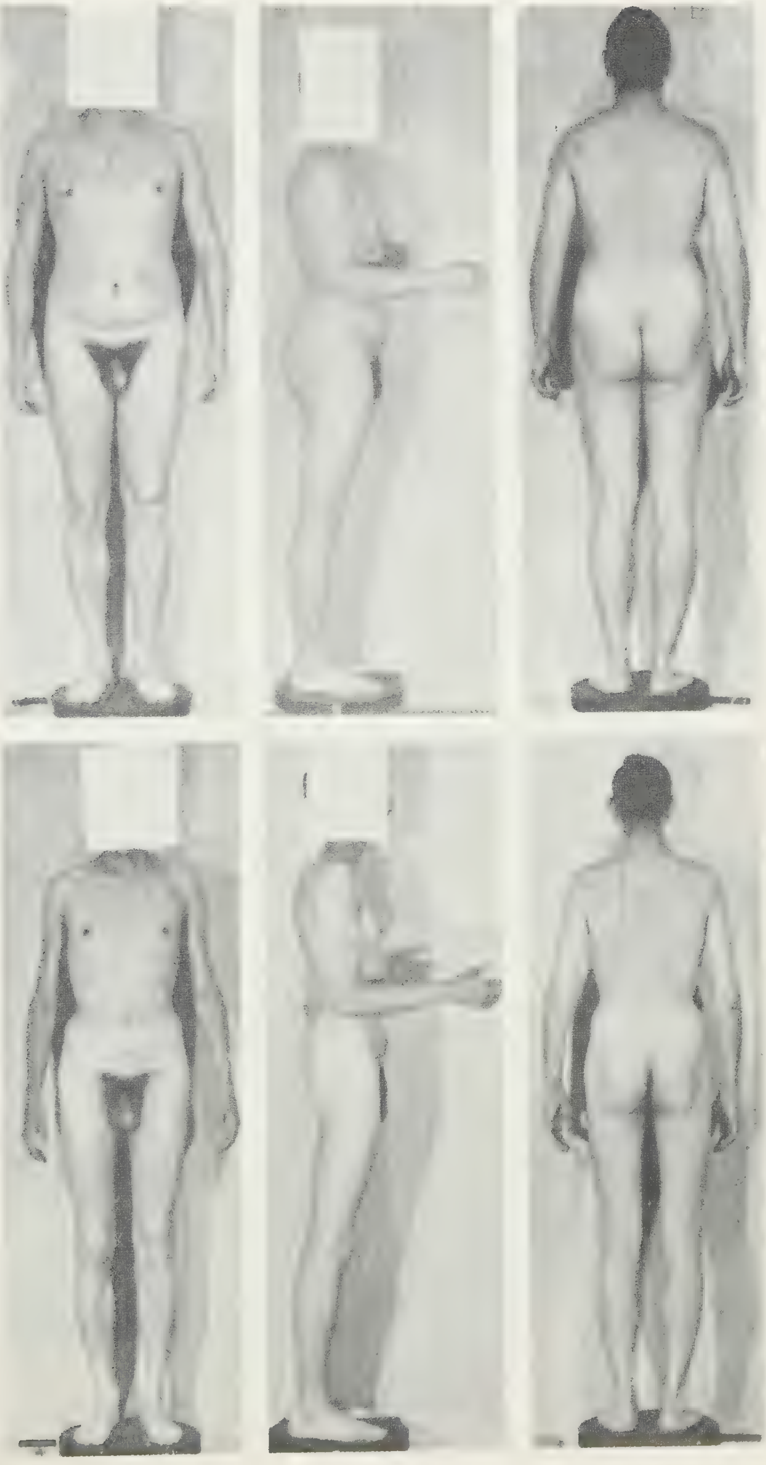


PLATE 3

EXPLANATION OF FIGURES

Above. Control. Somatotype 3 5 2.
Below. After 24 weeks partial starvation. Somatotype 2 4 5.

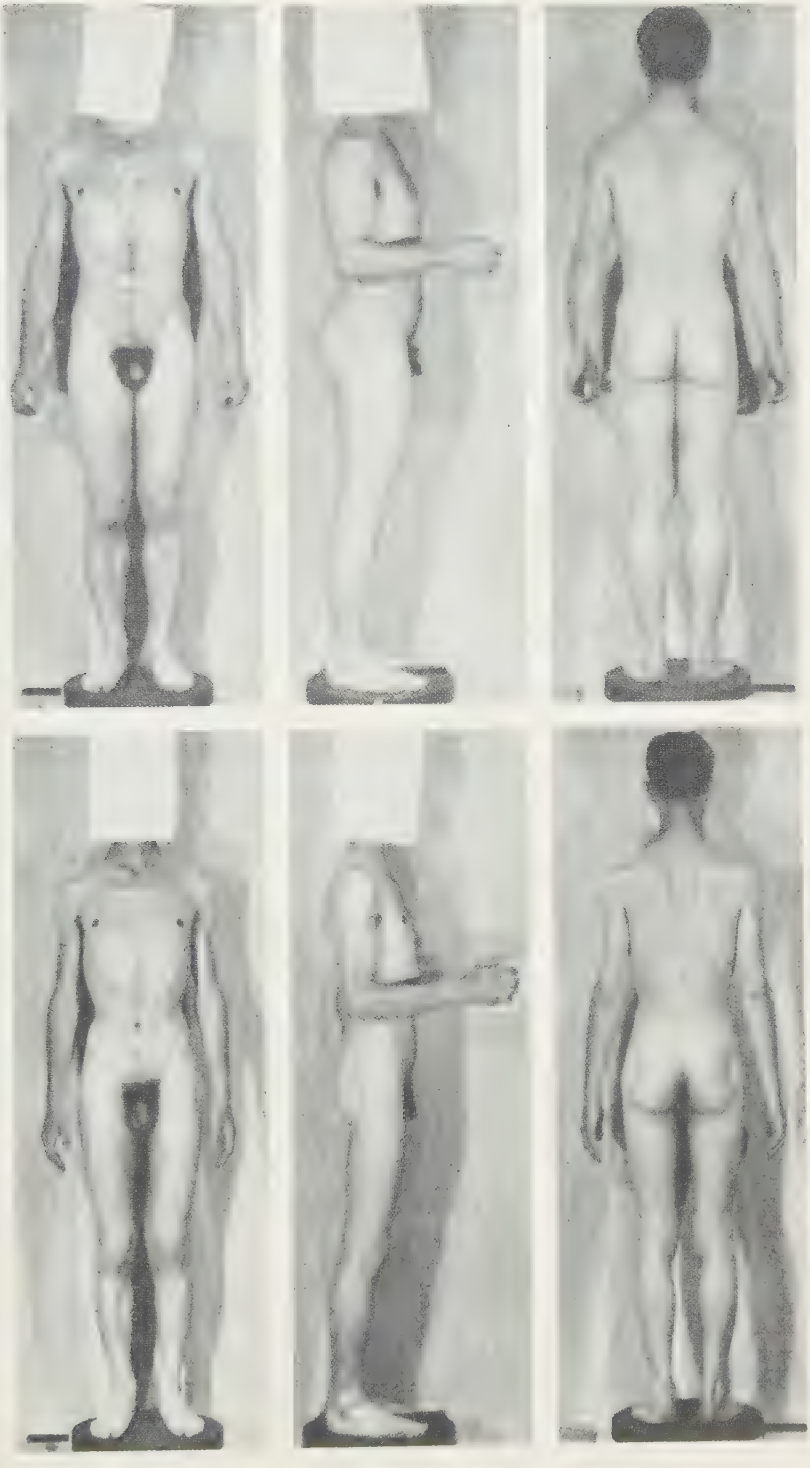
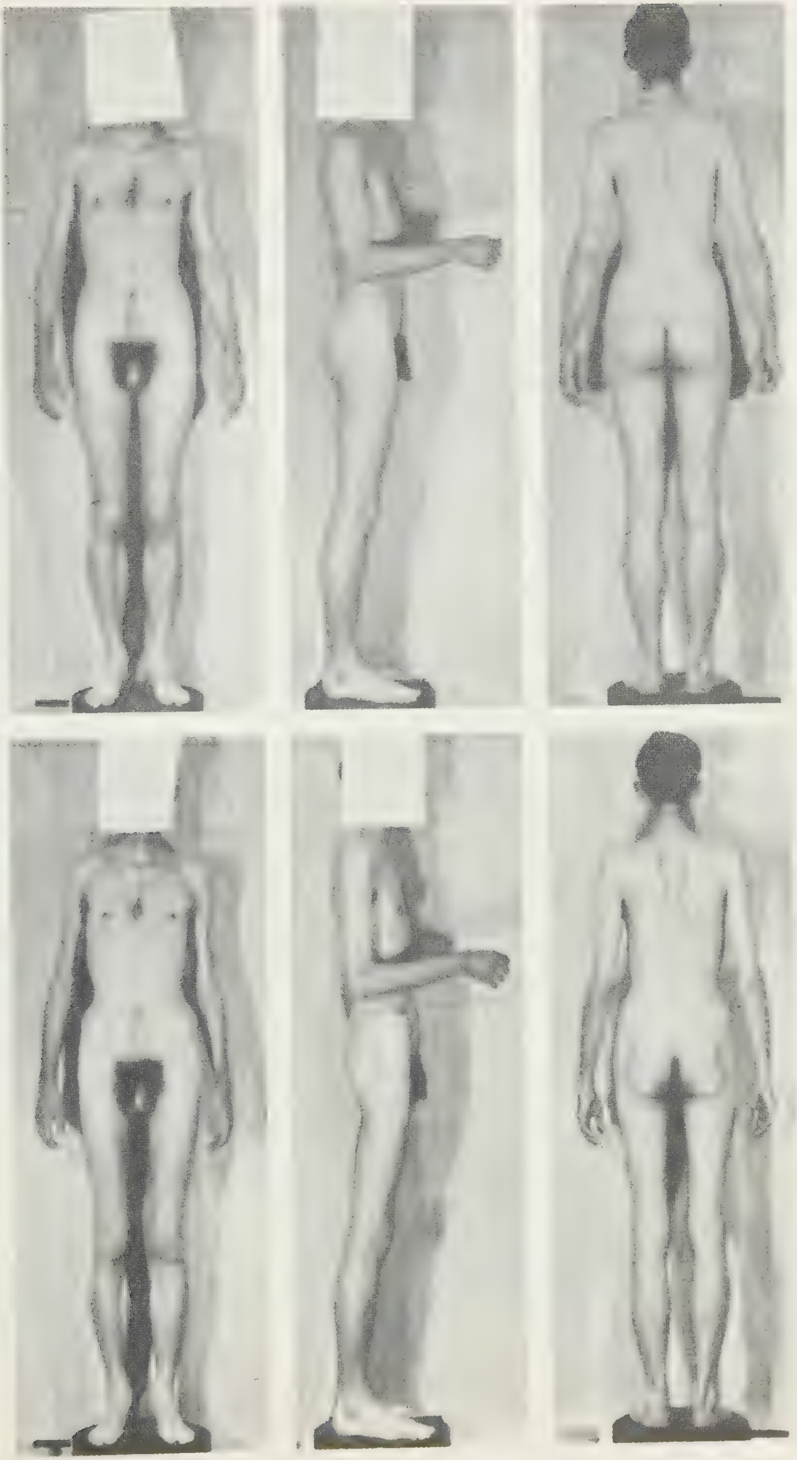


PLATE 4

EXPLANATION OF FIGURES

Above. Control. Somatotype 3 2 5.
Below. After 24 weeks partial starvation. Somatotype 2 2 6.



Vitamin-A Defiency and Bone Growth.— Bone is a peculiarly favorable tissue for the study of growth, because growth is not simply increase in size; it involves alterations of form. Bone, we know, undergoes continuous remodelling, rapidly during growth, slowly thereafter; and because of this and similar responses common in pathological conditions, it is to be regarded as an exceedingly labile tissue . . .

In vitamin-A deficiency, all epiphyseal-cartilage sequences cease . . . remodelling ceases and appositional bone formation continues at different rates in locations which vary with the species, but which are in conformity with each normal growth pattern.

The long bones of vitamin-A-deficient animals are shorter and thicker than those of normal animals. The shortness of the long bones is the result of failure of endochondral bone growth. The increased thickness is produced by continued appositional bone growth and, near the ends of bones, by retardation of remodelling sequences in the final period of growth before complete deficiency is established . . .

In the case of the skull, the problem is a complicated one, because of the intimate relations of the individual bones to one another in the absence of joints, and because of the many epiphyses or sites of endochondral bone growth and directions of such growth in the bones comprising the base of the skull . . . The bones of the calvarium of membranous origin normally increase their areas by appositional bone growth at the sutures. Change in radii of curvature also takes place as the cranial capacity increases. In the normal, these 2 features of growth — area increase of individual bones and changes in curvature — result in a pattern of growth of the membranous bones, in which there is resorption of bone on the exterior of the skull and deposition of bone on the interior surface. This remodelling of flat bones of the skull is suppressed in vitamin-A deficiency, as well as the remodelling of bones of cartilaginous origin, and results in thicker bones, cancellous in structure.— S. Burt Wolbach. Vitamin-A deficiency and excess in relation to skeletal growth. J. Bone and Joint Surg., vol. 29, 1947, pp. 171–192.

MEAN BODY SIZE OF MINNESOTA SCHOOLBOYS OF FINNISH AND ITALIAN ANCESTRY

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This paper describes and compares North American schoolboys of 2 ethnic groups. Chronologically, it deals with the postnatal period from 6 to 17 years of age; anthropometrically, it encompasses 16 different morphologic traits; and statistically, it restricts attention to central tendency.

SUBJECTS

The subjects were drawn from some 30 communities within a radius of 50 miles of Hibbing, Minnesota. They were obtained through the schools during 1938–1939, all available boys being accepted who (a) met 1 of 2 ethnic criteria and (b) were free from gross physical pathology. The selection procedure was as follows: Initially, every boy was considered a potential subject whose parents were both of Finnish ancestry, or, both of Italian ancestry; subsequently, there were a few rejections for evident body deformity. A total of 1,986 boys was subjected to study — 1,102 of this total represented boys of Finnish lineage, and 884 boys of Italian lineage.

In order to characterize the samples from the standpoint of socio-economic composition, information was sought pertaining to annual family income and occupation of father. It was possible to obtain an approximate figure for family income on $\frac{4}{5}$ of the subjects and a designation of paternal occupation on almost all of them. Distribution of the former data showed annual family income to be "$1,500 or under" for 84% of each ethnic group, and "over $2,000" for less than

4% of each group. Both groups also gave similar distributions for occupation of father; upwards of 80% of the tallies falling in the categories for unskilled and semiskilled workmen.

Summarily, the subjects consist of 2 series of physically normal white boys. Both series typify the same secular period, the same geographic location, and similar occupational samplings. The series differ in morphologic and cultural ancestry, each being homogeneous to the extent of representing offspring of emigrants from a single European country (Finland or Italy).

DATA

As already indicated, collection of the data took place simultaneously on both samples (during the years 1938–1939). All examinations were made on the nude subject, using rigorously specified methods. Further, the boys of both samples were measured by the same anthropometrist (Matheny). An itemization of the measurements taken, together with the anthropometric techniques employed, follows:

Stature. Erect body length from soles to vertex was measured using an upright board — to which was attached a Baldwin millimeter scale — and a wooden square. The subject stood with heels almost touching each other, and with heels, buttocks, upper part of back, and rear of head in contact with the board. As the square was brought down upon the vertex, care was taken to see that the subject kept his heels in firm contact with the floor.

Trunk length. In taking this measurement, a horizontal walnut bench 40 cm in height was placed at the base of the upright board. The subject sat on this bench with his ankles crossed, his knees spread apart, and the posterior aspect of his trunk in contact with the board both at the sacral and upper thoracic regions. Trunk length was determined with wooden sliding calipers as the distance from the upper surface of the bench to supersternale. The fixed arm of the calipers rested on the bench and was directed away from the subject: the sliding arm extended toward the subject and its terminal point was brought down upon "the highest point of the sternal notch in the median plane."

Head and neck length. This dimension was derived by subtracting trunk length from sitting height. Sitting height was obtained with the subject in the same position as for trunk length: following determination of trunk length, the anthropometrist laid aside the sliding calipers, oriented the head on the Frankfort Plane, and brought the wooden square into firm contact with the vertex.

Length of lower extremities. This dimension was derived by subtraction of sitting height from stature. Considered jointly, head and neck length, trunk length, and length of the lower extremities will be seen to comprise a subdivision of stature into its 3 major components.

Shoulder width. Bi-acromial diameter was measured. The subject stood erect with arms extended downward, and with shoulders neither ''slumped forward'' nor ''thrown back.'' Broad-arm aluminum sliding calipers were applied under conditions of moderate pressure.

Hip width. Hip width was determined as bi-iliocristal diameter. The anthropometrist stood in front of the subject, brought the arms of the calipers squarely in contact with the landmarks, and used very firm pressure. In the event the subject appeared to turn his hips as the pressure was applied, the measurement was retaken.

Length of upper extremities. The left limb was measured, employing wooden sliding calipers. After extending the limb at the side of the body and rotating the manus so that its palmar surface faced the lateral surface of the thigh, the distance was found from ''the most lateral point of the acromion process'' to ''the most distal point of the middle finger.'' In application of the instrument, the shaft was kept parallel with the long axis of the limb and care was taken to guard against any tilting of the shoulder axis.

Chest girth. Using a steel millimeter tape, the circumference of the thorax was determined at the level of the xiphoid cartilage and in a plane at right angles to the vertebral column. The subject stood in a natural manner with head erect, and with arms relaxed and held slightly away from the sides of the body in order to permit the passing of the tape around the thorax. The tension applied was only sufficient to enable the tape to rest against the perimeter of the thorax without slipping. The objective was to obtain median girth during normal respiration.

Arm girth. The subject stood with the upper extremities hanging at the sides of the body. The left extremity was slightly abducted so that the arm was not in contact with the lateral wall of the thorax: after passing the tape around the left arm approximately halfway between the acromion and radiale, the anthropometrist explored this area (with the tape always at right angles to the line of the humerus) until the greatest girth below the insertion of the deltoid muscle was located. The record was taken with the tape in sufficiently light contact with the skin to avoid compression of the tissues.

Thigh girth. This measurement was secured as the circumference of the left thigh ''at the level of the maximum medial projection of its inner aspect below the gluteal sulcus'' and ''at right angles to its long axis.'' The subject stood with feet spread about 9 inches apart (so that the inner aspect of 1 thigh was not in contact with that of the other) and with his weight equally distributed through both lower extremities. The anthropometrist moved to the rear of the subject, passed the tape around the thigh, and adjusted it in position taking care that its contact was not sufficient to indent the skin.

Leg girth. The subject maintained the position assumed for measurement of thigh girth. The tape was passed around the left leg, and the region of the calf explored until the maximum reading at right angles to the long axis of the leg was obtained. The reading was made with the tape in ''light contact'' with the skin.

Head length. Instrument: spreading calipers. The tip of 1 branch of the calipers was brought into contact with glabella, while the tip of the other branch was moved up and down the back of the head in the median plane until the greatest antero-posterior diameter was found.

Head width. The ends of the spreading calipers were placed against the sides of the head and moved in a horizontal plane until the maximum width was located.

Face width. Maximum bi-zygomatic diameter was sought by applying the ends of the spreading calipers against the sides of the face and moving them back and forth along the zygomatic arches.

Face length. Instrument: small sliding calipers. Nasion-menton diameter was found using the procedure of attempting to place 1 arm of the calipers against ''the point of the nose crossed by a line tangent to the superior palpebral sulci'' and bringing the other arm in contact with ''the lowest point of the mandible in the median plane.'' While the mouth was always closed, measurements were taken without regard to occlusion of the teeth.

Weight. The anthropometrist frequently checked and, if necessary, adjusted the scales. The subjects were requested to stand in the center of the scales platform, and care was taken that at the time of weighing their hands were not in contact with a wall or other object. As mentioned previously, weight was taken nude.

ANALYSIS AND RESULTS

The first step in analysis of the data was that of separating the records by ethnic group. This gave 1,102 record sheets for boys of Finnish descent and 884 for those of Italian descent. Next, the records for each ethnic group were distributed into 12 age subdivisions. Results from this step are shown in the following tabulation:

AGE GROUP (YRS.)		NUMBER OF SUBJECTS	
Midpoint	Range	Finnish ancestry	Italian ancestry
6	5.5– 6.49	52	40
7	6.5– 7.49	83	50
8	7.5– 8.49	92	51
9	8.5– 9.49	93	59
10	9.5–10.49	92	69
11	10.5–11.49	100	79
12	11.5–12.49	98	80
13	12.5–13.49	102	80
14	13.5–14.49	93	90
15	14.5–15.49	100	93
16	15.5–16.49	101	93
17	16.5–17.49	96	100

The last row of this tabulation indicates that 196 record sheets were amassed on boys between 16.5 and 17.5 years of age — 96 on boys of Finnish lineage and 100 on boys of Italian lineage. The preceding figures have comparable meaning.

The third step in analysis was that of calculating the arithmetic mean for each morphologic trait on every ancestry-age subgroup. In this connection it is relevant to note that there was no discrepancy between number of subjects in the study and number of measures for each trait. For instance, the record sheets of the 52 boys of Finnish ancestry representing age 6 each carried data for all 16 morphologic traits. It follows, then, that the number of measures used in computing the 384 means presented in tables 1 and 2 was never less than 40 (see the foregoing tabulation), while for 75% of the means (*i.e.*, for 18 of the 24 subgroups on each trait) it exceeded 70.

Tables 1 and 2 have been arranged to constitute independent morphologic descriptions of the 2 ethnic samples. Table 3 compares the 2 samples: explicitly, it lists the differences obtained by subtracting each mean in table 2 from the corresponding mean of table 1. Table 3 will be discussed first with reference to comparative findings for direction of differences. Directional findings are:

TABLE 1

Central tendency values (means) for 16 morphologic traits on North American schoolboys of Finnish ancestry. (Weight is in kilograms, all other traits in centimeters.)

AGE	STATURE	HEAD AND NECK LENGTH	TRUNK LENGTH	LOWER LIMB LENGTH	SHOULDER WIDTH	CHEST GIRTH	HIP WIDTH	UPPER LIMB LENGTH
(yrs.)								
6	115.0	24.9	37.3	52.8	25.5	54.3	19.1	48.9
7	121.2	25.6	39.2	56.4	26.5	56.1	19.8	51.8
8	127.0	26.2	41.1	59.7	27.5	57.8	20.4	54.5
9	132.0	26.7	42.7	62.6	28.4	59.5	21.1	56.6
10	137.0	27.2	44.2	65.6	29.5	61.6	21.8	59.4
11	141.6	27.7	45.7	68.2	30.5	63.6	22.5	61.6
12	146.8	28.3	47.4	71.1	31.4	65.8	23.3	64.3
13	152.4	29.0	49.3	74.1	32.5	68.4	24.2	66.4
14	158.5	29.7	51.6	77.2	34.0	71.2	25.3	69.9
15	164.4	30.6	53.8	80.0	35.5	74.3	26.3	72.3
16	169.7	31.5	55.9	82.3	37.0	77.9	27.2	75.2
17	173.7	32.4	57.7	83.6	38.4	82.1	28.1	76.7

	HEAD LENGTH	HEAD WIDTH	FACE LENGTH	FACE WIDTH	ARM GIRTH	THIGH GIRTH	LEG GIRTH	WEIGHT
6	18.1	14.3	9.2	11.7	17.2	34.0	23.0	21.3
7	18.2	14.4	9.4	11.8	17.5	35.2	23.7	23.5
8	18.3	14.5	9.6	11.9	17.9	36.5	24.4	25.7
9	18.4	14.6	9.7	12.0	18.4	37.8	25.2	27.9
10	18.5	14.7	9.8	12.2	19.0	39.4	26.2	30.5
11	18.6	14.8	10.0	12.4	19.7	41.0	27.3	33.4
12	18.7	14.8	10.2	12.5	20.6	42.8	28.4	37.2
13	18.8	14.9	10.4	12.6	21.6	44.7	29.8	41.3
14	18.9	15.0	10.7	12.8	22.7	46.7	31.1	46.3
15	19.0	15.1	11.0	13.0	24.0	48.6	32.4	52.1
16	19.1	15.2	11.3	13.1	25.2	50.2	33.6	57.7
17	19.2	15.3	11.6	13.3	26.2	51.3	34.3	63.2

1. Schoolboys of Finnish ancestry exceed schoolboys of Italian ancestry at ages 6 to 9 years for face length; at ages

6 to 11 years for head width and face width; and at every age studied for stature, weight, head length, head and neck length, and all dimensions of the trunk and extremities.

TABLE 2

Central tendency values (means) for 16 morphologic traits on North American schoolboys of Italian ancestry. (Weight is in kilograms, all other traits in centimeters.)

AGE	STATURE	HEAD AND NECK LENGTH	TRUNK LENGTH	LOWER LIMB LENGTH	SHOULDER WIDTH	CHEST GIRTH	HIP WIDTH	UPPER LIMB LENGTH
(yrs.)								
6	113.1	24.4	36.8	51.9	25.4	54.1	19.0	48.1
7	119.3	25.2	38.7	55.4	26.4	55.8	19.7	50.9
8	125.0	25.9	40.5	58.6	27.4	57.5	20.3	53.6
9	130.0	26.4	42.2	61.4	28.3	59.2	21.0	55.6
10	134.7	26.8	43.7	64.2	29.3	61.1	21.7	58.2
11	139.1	27.3	45.1	66.7	30.3	63.0	22.4	60.5
12	144.3	27.9	46.9	69.5	31.3	65.1	23.2	63.3
13	149.6	28.5	48.8	72.3	32.4	67.5	24.1	65.3
14	155.5	29.3	50.9	75.3	33.9	70.2	25.2	68.9
15	161.4	30.2	53.2	78.0	35.3	73.3	26.2	71.0
16	166.9	31.2	55.4	80.3	36.9	76.6	27.1	73.8
17	171.1	32.1	57.3	81.7	38.2	80.6	28.0	75.7
	HEAD LENGTH	HEAD WIDTH	FACE LENGTH	FACE WIDTH	ARM GIRTH	THIGH GIRTH	LEG GIRTH	WEIGHT
6	18.0	14.2	9.1	11.6	17.0	33.6	22.7	20.4
7	18.1	14.3	9.3	11.7	17.2	34.7	23.3	22.7
8	18.2	14.4	9.5	11.8	17.6	36.0	24.1	24.9
9	18.2	14.5	9.6	11.9	18.1	37.2	24.8	27.1
10	18.3	14.6	9.8	12.1	18.7	38.7	25.7	29.5
11	18.4	14.7	10.0	12.3	19.3	40.3	26.7	32.1
12	18.5	14.8	10.2	12.5	20.2	42.1	27.9	36.0
13	18.6	14.9	10.5	12.6	21.2	44.0	29.2	40.5
14	18.7	15.0	10.9	12.8	22.3	45.9	30.4	45.5
15	18.7	15.1	11.2	13.0	23.6	47.7	31.7	50.9
16	18.8	15.2	11.5	13.1	24.8	49.4	33.0	56.0
17	18.9	15.3	11.8	13.3	25.9	50.7	33.7	61.6

2. There is no difference between the 2 ethnic groups in head width at ages 12 to 17 years, in face length at ages 10 to 12 years, nor in face width at ages 12 to 17 years.

3. Over the age period from 13 to 17 years, face length is greater on the boys whose ancestors came from Italy than on those whose ancestors came from Finland.

TABLE 3

Differences in 16 morphologic traits between North American schoolboys of Finnish and Italian lineage. (Weight is in kilograms, all other measures in centimeters.)

AGE	STATURE	HEAD AND NECK LENGTH	TRUNK LENGTH	LOWER LIMB LENGTH	SHOULDER WIDTH	CHEST GIRTH	HIP WIDTH	UPPER LIMB LENGTH
(yrs.)								
6	1.9	0.5	0.5	0.9	0.1	0.2	0.1	0.8
7	1.9	0.4	0.5	1.0	0.1	0.3	0.1	0.9
8	2.0	0.3	0.6	1.1	0.1	0.3	0.1	0.9
9	2.0	0.3	0.5	1.2	0.1	0.3	0.1	1.0
10	2.3	0.4	0.5	1.4	0.2	0.5	0.1	1.2
11	2.5	0.4	0.6	1.5	0.2	0.6	0.1	1.1
12	2.5	0.4	0.5	1.6	0.1	0.7	0.1	1.0
13	2.8	0.5	0.5	1.8	0.1	0.9	0.1	1.1
14	3.0	0.4	0.7	1.9	0.1	1.0	0.1	1.0
15	3.0	0.4	0.6	2.0	0.2	1.0	0.1	1.3
16	2.8	0.3	0.5	2.0	0.1	1.3	0.1	1.4
17	2.6	0.3	0.4	1.9	0.2	1.5	0.1	1.0

	HEAD LENGTH	HEAD WIDTH	FACE LENGTH	FACE WIDTH	ARM GIRTH	THIGH GIRTH	LEG GIRTH	WEIGHT
6	0.1	0.1	0.1	0.1	0.2	0.4	0.3	0.9
7	0.1	0.1	0.1	0.1	0.3	0.5	0.4	0.8
8	0.1	0.1	0.1	0.1	0.3	0.5	0.3	0.8
9	0.2	0.1	0.1	0.1	0.3	0.6	0.4	0.8
10	0.2	0.1	0.0	0.1	0.3	0.7	0.5	1.0
11	0.2	0.1	0.0	0.1	0.4	0.7	0.6	1.3
12	0.2	0.0	0.0	0.0	0.4	0.7	0.5	1.2
13	0.2	0.0	—0.1	0.0	0.4	0.7	0.6	0.8
14	0.2	0.0	—0.2	0.0	0.4	0.8	0.7	0.8
15	0.3	0.0	—0.2	0.0	0.4	0.9	0.7	1.2
16	0.3	0.0	—0.2	0.0	0.4	0.8	0.6	1.7
17	0.3	0.0	—0.2	0.0	0.3	0.6	0.6	1.6

Comparative findings which take into account both direction and magnitude of differences are:

1. For head length and chest girth, the difference between the 2 ethnic groups (see table 3) increases with age.

In relation to schoolboys of Italian descent, schoolboys of Finnish descent have longer heads by 0.1 cm at ages 6 to 8 years, by 0.2 cm at ages 10 to 13 years, and by 0.3 cm at ages 15 to 17 years; correspondingly, they have larger chest girths by roughly 0.3 cm, 0.7 cm, and 1.3 cm, respectively.

2. For stature, the 3 components of stature, upper limb length, and the girths of arm, thigh and leg, the differences between the 2 ethnic groups show a trend of increase with age up to about 15 years, followed by a slight decrease. In stature, for instance, schoolboys of Finnish lineage surpass those of Italian lineage by 1.9 cm at 6 years, 3.0 cm at 15 years, and 2.6 cm at 17 years.

3. For shoulder width and hip width, the difference between the 2 ethnic groups remains constant. The difference — although registered throughout the entire age interval studied — is quite small on both traits: subjects of Finnish ancestry exceed those of Italian ancestry by 0.1 cm in hip width and by slightly more than 0.1 cm in shoulder width.

4. For head width and face width, there is a slight yet consistent difference between the 2 ethnic groups over the years 6 to 11, followed by a sustained equivalence during the latter half of the age span covered. In relation to the head and face width means on offspring of emigrants from Finland, those on offspring of emigrants from Italy are smaller by 0.1 cm during the age interval 6 to 11 years and identical during the interval 12 to 17 years.

5. For face length, the difference between the 2 ethnic groups undergoes change during the elementary and high school years in both magnitude and direction. Compared with boys of Finnish ancestry, boys of Italian ancestry are found to have shorter faces by 0.1 cm at ages 6 to 8 years, faces of equal length at ages 11 and 12 years, and faces longer by 0.2 cm at ages 15 to 17 years.

6. For those measures in which boys of Italian descent are exceeded by those of Finnish descent at every age studied, representative overall figures (*i.e.*, means of the difference values at the 12 ages) approximate 1.1 kg for weight, 2.4 cm

for stature, 1.5 cm for lower limb length, 1.1 cm for upper limb length, 0.7 cm for chest girth and thigh girth, 0.5 cm for trunk length and leg girth, 0.4 cm for head and neck length, 0.3 cm for arm girth, 0.2 cm for head length, and 0.1 cm for shoulder width and hip width.

Other studies on North American schoolboys whose ancestors came from a particular European country have been reported by Courtis ('39), Meredith ('39a), and Steggerda and Densen ('36). Steggerda and Densen published means for stature and weight at ages from 6 to 15 years based upon measurement of 1,900 white boys whose ancestors came from the Netherlands. Their data were collected during 1931 in the schools of Holland, Michigan. Utilizing records on more than 16,000 white boys of Polish ancestry measured in the schools of Hamtramck, Michigan, Courtis obtained means for stature covering the age period 6 to 15 years. Presumably these measurements were made about 1938. Meredith reported stature means at ages 7 to 17 years on white boys of Italian descent: the data employed were consecutive annual measurements accumulated by the Harvard Growth Study on 80 boys in attendance at the public schools of Beverly and Revere, Massachusetts, during the years 1923–1934. Comparative findings with reference to these investigations are:

1. The stature means of the present study for boys of Finnish descent are considerably higher than the Courtis means for boys whose ancestors came from Poland, and considerably lower than the Steggerda and Densen means for boys of Dutch descent. The average discrepancy is 2.9 cm in the former alignment, and 2.8 cm in the latter. Both series of differences tend to increase with age. The boys of Polish descent average 2.0 cm shorter than those of Italian descent over the years 6 to 10, and 3.8 cm shorter over the years 11 to 15. For the same age subdivisions, boys of Dutch ancestry are taller on the average than those of Finnish ancestry by 2.3 cm and 3.3 cm, respectively. While boys of Finnish lineage are shorter than those of Dutch lineage, they do not weigh

less. On the whole, the weight means from the Finnish sample are slightly higher than those from the Dutch sample.

2. The stature means of the present study for boys of Italian descent are markedly higher than the Meredith means for boys of Italian descent, and similar (ages 6 to 11) or somewhat lower (ages 12 to 15) than the Courtis means for boys of Polish descent. The average discrepancy between the 2 samples of boys whose ancestors came from Italy is 5.0 cm: sub-averages are 5.6 cm for the age period 7 to 11, and 4.3 cm for the period 13 to 17. The trend toward decreasing discrepancy with age may accrue, at least in part, from the fact that the Massachusetts data represent an earlier secular period than the Minnesota data by 15 years at age 7, 10 years at age 12, and 5 years at age 17.[1] In relation to boys of Polish ancestry, the Minnesota boys of Italian ancestry are found to have approximately the same stature over the elementary school years, and to be taller by an average of 1.7 cm over the years 13 to 15.

Using anthropometric data collected between 1929 and 1937 on North American private school boys of northwest European ancestry, Meredith ('39b) studied the 3 stature components, length of head and neck, trunk length, and length of lower extremities. At each age from 7 to 17 years, values were obtained expressing the means of the 3 components as percentages of mean stature. Major findings were: (1) the head and neck component of stature decreases continuously from 7 to 15 years, (2) the trunk component increases over the period 12 to 17 years, and (3) the lower limb component increases between 7 and 14 years and decreases between 14 and 17 years. For the 2 ethnic groups under study in the present paper, these findings are confirmed.

1. Head and neck length decreases on boys of Finnish descent from 21.7% of stature at age 6 to 18.6% of stature at age 15. On boys of Italian descent, there is a comparable steady decrease from 21.6% to 18.7%.

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[1] For findings pertaining to secular change in the stature of North American schoolboys, see Meredith ('41a, '41b), and Meredith and Meredith ('44).

2. Trunk length maintains a roughly constant percentage of stature over the years 6 to 11, and increases between ages 12 and 17 from 32.3% to 33.2% in boys of Finnish ancestry and from 32.5% to 33.5% in boys of Italian ancestry.

3. Lower limb length for boys of Finnish lineage rises from 45.9% of stature at 6 years to 48.7% at 14 years, and then declines to 48.1% at 17 years. The corresponding trend for boys of Italian lineage is characterized by percentages of 45.9, 48.4, and 47.7 at ages 6, 14, and 17, respectively.

On the whole, the components of stature are similar for the 2 ethnic groups. The largest differences occur in the relative amounts of trunk and lower limb during the age period 12 to 17 years: compared with the stature of boys of Italian ancestry, that of boys of Finnish ancestry comprises a slightly smaller trunk component and a slightly larger lower limb component.

SUMMARY

A descriptive and comparative investigation is reported on the mean size of North American schoolboys of 2 ethnic groups. For each group, means are presented at successive annual ages from 6 to 17 years. Sixteen different physical traits are characterized, the data for 14 consisting of direct measurements of the body and that for the other 2 of derived measures.

The subjects — approximately 1,100 boys of Finnish ancestry and 880 of Italian ancestry — were secured through schools in the vicinity of Hibbing, Minnesota. In addition to being obtained in the same geographic region, both series of subjects were studied at the same time (1938–1939), were examined by the same anthropometrist (Matheny), and were similar for socio-economic status (fathers predominantly unskilled or semiskilled workmen).

Findings are drawn first from the original materials on schoolboys whose ancestors came from Finland and Italy, and then from reference to materials in the literature on North American white schoolboys whose ancestors came from other European countries (*e.g.*, the Netherlands, Poland).

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PHYSICAL VS. CHEMICAL ASPECTS OF FOODS.— The diets of most primitive peoples are qualitatively and quantitatively deficient in nutrient value. They are monotonous, poorly balanced, and lacking in many essential elements necessary for the normal growth and development of a healthy body. However, despite their poor nutritive level, members of the average primitive groups studied have been found to possess large, well developed jaws and healthy teeth. We feel that this is due to the physical qualities of their diet. The foods are hard, bulky, fibrous and resistant. They stimulate function of the masticatory organs, and keep these structures in a state of health despite their unbalanced and inadequate chemical contributions. In studying dietary factors in dental abnormality and disease, more stress should be placed on the physical state and the mechanical action of foods as a functional stimulant, rather than on the chemical and nutritional aspects of the subject.— Meyer Klatsky. Studies in the dietaries of contemporary primitive peoples (Abstract). Sci. Proc. N. Y. Sec. Intern. Assn. Dent. Res., J. Dent. Res, vol. 26, 1947, pp. 173–174.

HISTORY OF DISCOVERIES IN SEX HEREDITY.— It might be well to call attention to the multiplicity of the connections between the inheritance of sex and the inheritance of other factors. This, of course, was not realized at the beginning of the twentieth century, and many errors of interpretation were made in attempts to fit all the various types into a single simple explanation. The rediscovery of Mendel's work gave a clue to the mechanism of the various types of heredity. However, long before Mendelian factors were known, many accurate and valuable observations were made, and the actual relationship between sex and the expression of certain characters was correctly recorded.— Conway Zirkle. The discovery of sex-influenced, sex-limited and sex-linked heredity. Chapt. 6 in *Studies and essays in the history of science and learning in honor of George Sarton* (Ed. by M. F. Ashley Montagu). Henry Schuman, N. Y., 1947, xiv + 597 pp.

ACQUIRED A–B AND RH SENSITIZATION.— Nature seems to have provided a special mechanism to protect infants of groups A, B and AB from the maternal alpha and beta isoantibodies, namely, the low sensitivity of the A and B agglutinogens in the fetal red cells. This appears to be another instance of ontogeny recapitulating phylogeny. In rhesus monkeys reactions are obtained corresponding to the human blood group B; however, while anti-A agglutinins are present in rhesus serum, no B agglutinogens are demonstrable in the red cells, the B group substance being confined to the tissues and secretions. Similarly, in other monkeys there is also a reciprocal relation between group substances in tissues and the agglutinins in the serum, while agglutinogens are absent from the red cells. Only in anthropoid apes and man are A and B agglutinogens demonstrable in the red cells. Since the A and B agglutinogens are still imperfectly developed in the human fetus at birth, this mechanism diminishes the harmful effect of the maternal A and B isoagglutinins on the fetal red cells. In the case of the Rh factor, this protective mechanism is lacking, but instead the non-existence of natural Rh sensitivity and the rareness with which acquired sensitivity occurs serve to protect the fetus in all but a few cases.— Alexander S. Wiener. Pathogenesis of erythroblastosis fetalis. III. Illustrative case histories of A–B sensitization. Wiener Lab. Paper no. 1, 1946, 22 pp.

DISTRIBUTION OF THE BLOOD GROUPS, M–N, RH TYPES AND SECRETORS AMONG THE UTE INDIANS OF UTAH[1]

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There is perhaps no ethnic group that has proven to be more interesting for serological study than has the American Indian. When the blood group distribution among various tribes of Amerinds first began to be studied, it was uniformly observed (Matson and Schrader, '33, table p. 156) that putatively full-blooded Indians belonged predominantly to group O. So high was this incidence of O among various Indian tribes that workers were agreed that the American Indians were at one time a pure group O people, that they became separated from the rest of the human family before the A or B factors developed in the race, and that whenever the A or B isoantigens appear in putatively full-blooded Indians it indicates racial crossing.

The discovery (Matson, '33, '38; Matson and Schrader, '33), however, that approximately 80% of putatively full-blooded Blackfeet Indians belong to group A made the earlier conclusions no longer tenable. These observations suggested that the Blackfeet and related tribes were at one time a pure group A people representing a distinct and separate migration into this hemisphere. This conclusion was further strengthened by the fact that when rigid genealogical inquiry was made, rather than taking at face value the agency records as to the degree of blood purity, it was found that all individuals who

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[1] This work was aided by a grant from the Rockefeller Fluid Research Fund,

were known to be full-blooded Blackfeet belonged to group A (Matson, '46). Furthermore, Matson, Levine, and Schrader ('36) found that practically 100% of putatively full-blooded Blackfeet of group A belonged to the subgroup A_1. Aside from the Blackfeet, however, the larger body of Indians belong predominantly to group O. Such a tribe of Indians is the Ute of Utah in which tribe was found more than 97% of putative full-bloods belonging to group O (Matson and Schrader, '41).

Since the Blackfeet and the Ute Indians represent 2 entirely different groups with respect to their blood group distribution it seemed desirable to examine individuals of these 2 tribes for the distribution of the blood groups, Rh factor, and the secretor character among them and also to observe the distribution of the M and N factors among the Utes since such a study had not been made among these Indians but had among the Blackfeet (Levine, Matson and Schrader, '35; Matson, Levine and Schrader, '36). This report is that part of this study which deals with the distribution of these hereditary factors among the Ute Indians of Utah.

MATERIALS AND METHODS

The blood samples were collected by finger puncture. Several large drops of blood were allowed to fall into dry, chemically clean test tubes about 10 mm in diameter. The numbered tubes containing the clotted blood were stoppered and immediately put into a cooled water sample container, the ice compartment of which was refilled with ice before leaving on the 180-mile trip to the laboratory. The samples arrived at the laboratory in excellent condition, where they were immediately transferred to a refrigerator.

Saliva specimens were collected by having individuals chew paraffin and expectorate into large test tubes. These specimens were boiled within an hour after collection to destroy any enzymes specific for the blood group substance that may have been present. Upon arrival at the laboratory, the saliva specimens were placed in the refrigerator and the following day before testing they were autoclaved at 15 pounds pressure for 15 minutes.

The tests were started the following day and were completed within 2 days. Just prior to doing a group of tests, suspensions of cells were made by shaking up the clots in saline. The suspended cells were washed once and resuspended in saline solution to approximately a 2% suspension.

The anti-A and anti-B typing sera were of high titer and avidity. The same had been produced in group B and A volunteers respectively who had received intramuscular inoculations of group A and B substance of Witebsky which had been produced by Eli Lilly Company. High titered anti-A immune serum produced in rabbits by inoculating them with saline suspensions of cuticle from Ascaris lumbricoides was also used in these tests.

Human anti-Rh typing sera of 3 specificities, anti-C, anti-E, and anti-D,[2] (Rh′, Rh″, and Rh_o) were used. The anti-D (anti-Rh_o) typing serum had been obtained from a group A, Rh negative mother who had given birth to an erythroblastotic baby. Her D (Rh_o) antibody titer was 1:128. This serum was absorbed and processed in the Blood Grouping Laboratory in the Department of Bacteriology of the University of Utah Medical School. The anti-C (anti-Rh′) and anti-E (anti-Rh″) sera were obtained from Doctors L. K. Diamond and A. S. Wiener.

M and N typing sera were purchased from the Certified Blood Donor Service in Jamaica, New York, and appeared to be specific and of strong titer and avidity.

The blood group and M and N tests were done by placing in the depressions of a Kline slide a drop of the appropriate antiserum and a drop of 2% saline suspension of erythrocytes. The cells and sera were mixed and the slide placed on a Boerner-Kline rotator, covered with a petri dish and rotated at slow speed for 15 minutes. The tests were observed macroscopically and checked for fine clumping under the microscope.

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[2] The Fisher terminology is favored because of its simplicity and more accurate conformity to genetic nomenclature but because of the widespread use of Wiener's terminology in this country both are used simultaneously in this paper.

Rh testing was done in small 7 × 70-mm test tubes. For each test a drop of properly diluted anti-serum of each specificity, C (Rh′), E (Rh″), and D (Rh_o), was placed in a separate tube. To the drop of serum in each tube was added 1 drop of 2% saline suspension of the erythrocytes being tested. The tests thus set up were placed in a 37°C. water bath and incubated for 1 hour. The tubes were then removed, numbered, and centrifuged at slow speed (about 500 R.P.M.) for 1 minute. Examination for agglutination was done by rotating the tube slowly at an angle to remove the button of cells from the bottom of the tube. Agglutination was looked for macroscopically with the aid of a concave mirror observing the reflection in the mirror and also microscopically under the low power objective.

The procedure used for determining the A and B blood group antigens in saliva was essentially that of Yamakami ('26), and may be briefly described as follows: To varying dilutions of filtered specimens of autoclaved saliva were added 0.5 ml of O (αβ) serum, so diluted on the basis of a preliminary titration that it contained 8 times the minimal amount of agglutinin necessary to cause clumping of a 2% suspension of erythrocytes containing homologous agglutinogens. The mixtures were well shaken and allowed to remain in the refrigerator overnight, after which 0.2 ml of each mixture was delivered into each of 3 small test tubes containing 1 drop of a 2% suspension of washed erythrocytes belonging to group O, A, and B, respectively. After incubation for 30 minutes at 37°C. the mixtures were examined for agglutination.

Saliva specimens from a group A, B, or AB individual will absorb the homologous α or β agglutinin from O (αβ) serum if such a saliva specimen contains the antigen. On the other hand, the O saliva can contain neither A nor B isoantigen and therefore the α and β agglutinins in groups O serum can not be neutralized when treated with O saliva and would continue to agglutinate both A and B erythrocytes. Exactly the same thing would occur in nonsecretors of either O, A, or B antigens. To eliminate this uncertainty, use was made of the anti-O agglutinin present in selected beef sera which had been prepared by absorption with group A_1B human erythrocytes. This prepared anti-O bovine serum with proper controls was used for the detection of group O antigen in the saliva specimens from the Ute Indians following exactly the technique outlined above for the detection of the A or B antigens in saliva with the use of O (αβ) serum.

RESULTS AND DISCUSSION

In all, 104 specimens of putatively full-blooded Ute Indians were examined. The results of the distribution of the blood groups are shown in table 1.

TABLE 1

Distribution of the blood groups among full-blooded Ute Indians in Utah.

PEOPLE	NO. EXAMINED	BLOOD GROUP FREQUENCIES								GENE FREQUENCIES			SUM OF GENE FREQUENCIES
		O		A		B		AB					
		No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	p	q	r	p + q + r
Utes, present study	104	102	98.08	2	1.92	0	0	0	0	.01	0.0	.99	1.000
Utes, previous study[1]	138	135	97.39	3	2.61	0	0	0	0	.0132	0.0	.9868	1.000
Whites in Utah	985	463	47.00	414	42.04	96	9.74	12	1.22	.247	.050	.686	.983

[1] Matson and Schrader ('41).

For comparison is included the results of the 1941 study in which is shown the blood group distribution of Utes and of Whites in Utah. Approximately the same high percentage of group O is shown to be present in both groups of Utes. It is apparent therefore that about 98% of 104 putatively full-blooded Ute Indians belong to group O whereas only 2 individuals were found to belong to group A. These were both A_1. No B nor AB was found among these Indians. The finding of no A_2 is in agreement with the previous findings of Matson, Levine and Schrader ('36) among the Blackfeet and related tribes in which people there is a virtual absence of A_2 even though the frequency of A among them approaches 80%. Recently Wiener et al. ('45) found the same absence of A_2 among Mexican Indians. It should be mentioned also that A_2 is lacking or extremely rare among native Hawaiians (Nigg, '30) in which the distribution of the 4 blood groups resembles that of the Blackfeet Indians. Recent studies by Graydon and Simmons ('45) and Simmons and Graydon ('45) of the blood group of certain Pacific Island peoples reveal a virtual absence of A_2 among Filipinos, Papauans, and Fijiians. Similar absence of A_2 has been observed among Eskimos (Sewall), Chinese (Levine and Wong, '43; Wiener et al., '44b) Indonesians (Simmons et al., '45), and among Japanese (Waller and Levine, '44; Graydon and Simmons, '45). On the other hand, in White peoples, as many as one-fourth or one-fifth of A or AB individuals belong to A_2 (Landsteiner and Levine, '29), and the incidence of A_2 in Negroes is the highest reported so far in any race (Landsteiner and Levine, '29; Wiener et al., '44a). It seems that the incidence of A_2 is low or absent in the more primitive and isolated races.

The distribution of the M and N factors among the Ute Indians is shown in table 2.

TABLE 2

Distribution of the M and N factors among full-blooded Ute Indians in Utah.

PEOPLE	NUMBER EXAMINED	FREQUENCY OF TYPES						FREQUENCY OF GENES		SUM OF GENE FREQUENCY
		M		MN		N				
		No.	*%*	*No.*	*%*	*No.*	*%*	$m = \sqrt{M}$	$n = \sqrt{N}$	m + n
Utes	104	61	58.65	36	34.62	7	6.73	76.58	26.00	102.58
Blackfeet [1]	95	52	54.74	38	40.00	5	5.26	74.00	23.00	97.00
Whites	272	50	18.38	151	55.52	71	26.10	42.87	51.08	93.95

[1] Matson, Levine and Schrader ('36).

For comparison is shown the distribution of these factors among the Blackfeet and Whites. The 104 blood specimens from the Utes showed a high percentage of the M factor and a low percentage of N. There were 58.65% M, 6.73% N, and 34.62% MN. These findings are in essential agreement with those of Levine, Matson and Schrader ('35), and Matson, Levine and Schrader ('36) among the Blackfeet where only 2% were found to belong to type N, whereas among Whites in Montana 25% were type N. In essential agreement also are the studies made by Landsteiner and Levine ('29) in which studies were noted significant differences between Whites (with a distribution of approximately 30% M, 20% N, and 50% MN), and Indians in which M was 60%, N, 4.88%, and MN, 35.12%. The recent study by Wiener et al. ('45) among Mexican Indians reveals a similar distribution of the M and N factors as do other Indians and Eskimos.

Just why different tribes of Amerinds who differ so widely in the distribution of their blood groups as do the Blackfeet and Utes for example should resemble one another so closely with respect to the M and N factors is probably not known. Perhaps as Wiener suggests (Wiener et al., '45) the fact that the blood groups are determined by a series of 3 allelic genes, whereas the M–N types are determined by a pair of allelic genes, allows for greater leeway of variation in the case of the blood groups.

Among Australian aborigines (Birdsell and Boyd, '40; Wilson et al., '44), and the Ainu (Kubo, '36), however, the distribution of the M and N factors appear to be reversed, so that whereas among Eskimos and American Indians the frequency of the M factor is high and N is low, among the Australian aborigines and Ainu there is a high frequency of N and low M. The Bedouin (Boyd and Boyd, '38; Kayssi et al., '38) and Hindus (Greval et al.), like the Eskimos (Hansen) and Indians are low in N. All other peoples that have been examined appear to have a more equitable distribution of the M and N types.

The distribution of the Rh factors among the Ute Indians is shown in table 3.

TABLE 3

Distribution of the Rh blood types among the full-blooded Ute Indians in Utah. Other data for comparison.

PEOPLE	NO. EXAMINED	RH BLOOD TYPE FREQUENCIES															
		cde Rh −		CDe Rh$_1$		cDE Rh$_2$		CDE Rh$_1$Rh$_2$		cDe Rh$_0$		Cde Rh′		cdE Rh″		CdE Rh′Rh″	
		No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No*	*%*
Ute Indians, present study	104	0	0.0	35	33.66	30	28.84	39	37.50	0	0.0	0	0.0	0	0.0	0	0.0
Mexican Indians (Wiener et al.)	98	0	0.0	47	48.00	9	9.2	41	41.8	1	1.0	0	0.0	0	0.0	0	0.0
Whites (N.Y.C.) Wiener et al.	1,468		13.3		54.4		13.7		15.0		2.4		1.0		0.2	0	0.0

For comparison some data from Wiener et al. ('45) is also shown in the table. At a glance it may be seen from the table that there is a striking difference in the distribution of the various substypes of Rh among the Ute Indians and Whites. As in the earlier findings of Landsteiner, Wiener, and Matson ('42) among 120 Amerinds in Northwestern United States, so among the Utes no Rh negative individuals were found. This agrees also with Wiener's data on Mexican Indians. Sandoval et al. (personal communication), however, did find 1.42% Rh negative among 205 Mapuches Indians in Chili but they admit possible crossing of these Indians with Whites. Although Wiener found one individual belonging to type cDe (Rh$_0$) not one person of such type was found among the full-blooded Utes. The only subtypes observed among them were CDe (Rh$_1$), cDE (Rh$_2$), and CDE (Rh$_1$Rh$_2$). The subtypes cDe (Rh$_0$), Cde (Rh′), cdE (Rh″), or CdE (Rh′Rh″) were not found. Jordan ('46) found only one Rh negative individual among 369 Eastern Arctic Eskimos. Levine and Wong ('43) found only one Rh negative among 150 Chinese living in New York and Wiener et al. ('44b) also found among the Chinese an exceedingly high percent of Rh positive individuals. Similar results have been found by Simmons et al. ('44) among Australian aborigines, Indoesians, and other South Sea peoples as well as among the Japanese. Waller and Levine ('44) also observed a low incidence of Rh negative individuals among the Japanese. The absence of the Rh factor in a certain percentage of people seems to be a mutation that is almost peculiar to the more recent and advanced races. It appears that in the more primitive races all individuals possess Rh antigen.

Saliva specimens from 79 Ute Indians were examined for the presence of the blood group antigens, O, A, and B. All 79 individuals secreted the O or A substance in their saliva. Relatively few studies have been made on the racial distribution of this hereditary character. Such studies as have been made indicate that in Europe and in the United States about 80% of white individuals are "secretors" and 20% "non-secretors" (Schiff and Sasaki, '32; Matson and Brady, '36). The percentage of "secretors" appears to be slightly higher in Finland (Putkonen, '30) and markedly lower in Negroes (Schiff, '40). This study appears to be the first that has been made of the distribution of secretors among American Indians and the only group in whom 100% have been shown to be "secretors." The series of course is small — 79 individuals. Because the secretor character is hereditary and because there appears to be a difference in its distribution among different races and peoples, it may be important as an additional anthropological criterion.

SUMMARY

Distribution of the blood groups, M and N types, Rh blood types, and the "secretor" character has been studied among 104 putatively full-blooded Ute Indians. Of 104 individuals

examined, 102 or about 98% belonged to group O whereas only 2 individuals belonged to group A_1.

The distribution of the M and N factors is very similar to that observed in other Indians, namely, a high percentage of M and low N. Among 104 Utes, 61 or 58.65% belonged to type M, 7 or 6.73% were N, and 36 or 34.62% possessed both the M and N factors.

There were no cde (Rh negative) individuals found among 104 Ute Indians. The only subtypes found to be present were CDe (Rh_1), 33.66%, cDE (Rh_2), 28.84%, and CDE (Rh_1Rh_2), 37.50%.

Saliva specimens from all of 79 Ute Indians contained their respective isoantigen, either O or A antigen depending on the blood group to which they belonged.

ACKNOWLEDGMENTS

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INACCURACY OF MEASUREMENTS.— A criticism voiced from time to time concerning some of the anthropometric data published is that they are recorded to too fine a unit and give a misleading impression of accurracy . . . [There is no] virtue in ''whole numbers'' to render them more likely to represent the true . . . breadth. To read a measurement as 38 cm when the scale gives 384 mm is merely to add another inaccuracy to those that may have already affected the measurement. Whether it will help to correct or will exaggerate the others is purely a matter of chance.— M. L. Tildesley. Choice of the unit of measurement in anthropometry. Man, vol. 47, May, 1947, no. 75, pp. 72–78 (The article includes data and a method by which an observer ''may derive from the character-as-measured an improved estimate of the variability of the character itself and, in consequence, truer criteria of the significance of differences between his own observations and those obtained from other ethnic groups''— Ed.).

BRIEF COMMUNICATIONS

ARE HUMAN RACES IN THE TAXONOMIC SENSE "RACES" OR "SPECIES"?

"The question of race as applied to mankind is such a controversial and thorny one that we who discuss the subject as scientific men need to do so in a particularly calm and unbiased spirit." These are the introductory words of an article published in 1937 by R. Ruggles Gates entitled "Genetics and Race." In Gates' reply in the last issue of this Journal to my paper in which I dealt with specific and subspecific characters in man (Weidenreich, '46), the calm and unbiased spirit he recommended 10 years ago is entirely missing. Instead, he censures me heavily with imputations ranging from religious prejudice, mispresentation and misinterpretation, to "muddled thinking" caused by my incompetence in the field of human classification. I do not take this personal attack too seriously for the use of strong words in order to divert the innocent reader's attention from the main issue of a controversy and from the paucity of their own argumentation is an old ruse. Let us therefore return to the real issue.

Are the different main races of modern mankind "races" (subspecies) in the taxonomic sense, as all anthropologists have claimed to date, or are they equivalent to "species" in the taxonomic sense as the botanist Gates says? In other words, are the differences between human races greater than those usually found among races of other mammals like those of the dog, so that ranking them in the next higher category is justified? I have pointed out in my paper that no acknowledged group exists which permits objective measurement of the degree of its biological differences, and that for this reason each classification is arbitrary and a matter of convention. Fully aware of this fact I wrote: "Nobody has the authority to prevent anyone from splitting mankind into as many species or subspecies (or subsubspecies) as he wishes, but cogent reasons must be brought forward when the convention is disregarded. What Gates has produced cannot be accepted as satisfactory."

What is Gates' evidence? In his paper of 1937 he was much less insistent in this regard than he is today. Even the sentence introducing this statement sounds like an apology, for he wrote, "Of course it must be recognized that there is no sharp line between species and subspecies, or geographical races; and authors will always differ to some extent in the number of such forms which they would rank as species rather than races. Yet there are large numbers of cases in animals and plants where the ranking of particular forms as species or subspecies is clear and generally agreed upon'' (p. 29). His evidence and the statement regarding it were: (1) ''Human beings are heterozygous for many of their characteristics, some of which are racial and due to crossing, while many others are mutational in origin'' (p. 29); (2) In wild Gammarus (a small arthropod) and in 2 Drosophila species a certain percentage of individuals have been found which were heterozygous for a recessive gene. From this ''argument'' Gates deduces that he is ''justified in regarding the mongoloid, australoid, caucasoid and negroid types of man as presenting separate species'' (p. 30), yet he adds: ''The justification for this view will depend upon how long these 4 specific types have been evolving in separate geographic areas more or less isolated from each other'' (p. 30).

This is all that Gates brought forward in 1937, 1944 and today in favor of the theory of species, and not even an attempt has been made to estimate how much time it may have taken for these human types to evolve in separate geographical areas and how long and to what extent they are isolated. Gates may have been aware that his postulates can never be fulfilled. In any case, even if the stipulations he set up should be met, there is no justification for Gates' claims. As to his genetic references, it is not necessary to resort to Gammarus and Drosophila. Not a single individual in bisexually reproducing animals is known that it is not heterozygous in many of its genetic characteristics. The fact of heterozygosity has nothing to do with the taxonomic ranking of the population to which such an individual belongs. Heterozygotes are abundant even in the ''purest'' species. Why, therefore, restrict the category ''species'' to the 4 human groups selected by Gates and not extend it to all the others regardless of whether they come up to all his postulates or not?

Gates has announced the preparation of a book in which he will deal with human ancestry in the light of genetics. This is good news. As Gates doubts the human character of Gigantopithecus, suggesting he is an orangutan, many anthropologists will look forward with the keenest interest to his contribution to the discussion. It will reveal whether Gates' genetic methods are more trustworthy than the old proven comparative ones hitherto applied by morphologists to paleontological problems.

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VALIDITY OF THE PILTDOWN ASSOCIATIONS.— The most important find at site no. 2 [in the Piltdown gravel] was of another tooth. This is a left first lower molar. It agrees very closely with the teeth of the famous jaw from site no. 1, possessing the same 2 ape-like features: (1) that it is elongated antero-posteriorly, *i.e.* along the line of the jaw; and (2) that it has the 5 cusps of the "Dryopithecus pattern," while it also possesses the same 2 human features, the high crown and the vertical sides. The degree of wear of its grinding surface was different from that of the molars from site no. 1 in that it was worn more obliquely, this tooth was therefore definitely from a different individual. The evidence provided by this tooth seems to me to afford strong support to the view that the jaw from site no. 1 should be associated with the cranium. At both sites bones of similar crania were associated with teeth of precisely similar, and remarkable, type. It would have been just too bad if Nature had presented us with 2 human crania, found in the same stratum, but 2 miles apart, each intimately associated with an ape! If the association of jaw and cranium be accepted, then the Piltdown remains — *Eoanthropus dawsoni* — show us a most remarkable combination of human and ape-like features.— Walter H. Bennett. Glacial chronology and the Pekin and other prehistoric skulls. Proc. Croydon Nat. Hist. and Sci. Soc., 1946, pp. 179–202.

JEWISH INTERMARRIAGE IN ENGLAND.— Fifty Jews serving as soldiers in the Britsh Army were asked for details of their families . . . most of them were not themselves immigrants, but came of fathers or grandfathers who had immigrated into this country from Europe 1 or 2 generations ago.

[This] sample of British Jews . . . is a very small one and possibly not representative . . . Nevertheless the suggestion arises that . . . Social differences between Jews and non-Jews are . . . being dropped. Furthermore, it seems likely that the frequency of marriage with non-Jews has increased among Jews in recent years, and is now of the order of 1 in 8 marriages. Such a rate of intermarriage would, if maintained for a number of generations, assimilate the Jewish and non-Jewish populations.— Eliot Slater. A note on Jewish-Christian intermarriage. Eug. Rev., vol. 39, 1947, pp. 17–21.

NUTRITION DURING PREGNANCY.— The generalized undernutrition which occurred in Northwestern Holland during the winter of 1944–1945 was severe enough to interfere with the prenatal growth of infants born during that period. This was clearly shown for fetal weight, less definitely (but significantly) with regard to fetal length . . . Congenital malformations, which appear irregularly in normal times, and are attributable to other factors not explored, were so slightly increased among the few conceptions occurring at the worst stage of undernutrition that the results in this regard are inconclusive. In any situation of sudden severe undernutrition similar to that which occurred in Holland, the almost predictable intervention of amenorrhea would, in fact, make the collection of useful statistics regarding fetal anomalies almost impossible . . .

At the present we still lack sufficient knowledge to say that deviations from the best possible maternal diet will inevitably lead to unsatisfactory results of pregnancy. Nor do we know to what degree proper maternal diet may be efficacious in producing uncomplicated pregnancies or more healthy infants at birth. The occurrences in Holland, however, add support to the accumulating evidence from animal experiments and human nutrition studies, that fetal growth may be retarded by lack of proper maternal diet.— Clement A. Smith. Effects of maternal undernutrition upon the newborn infant in Holland (1944–1945). J. Ped., vol. 30, March, 1947, pp. 229–243.

REVIEWS

VERTEBRATE PALEONTOLOGY. By ALFRED SHERWOOD ROMER. University of Chicago Press, viii + 687 pp., 337 text figures, 4 tables, classification of vertebrates, bibliography, index, 1945. ($7.50).

The second edition of Professor Romer's widely used textbook of vertebrate paleontology has undergone extensive revision. The number of chapter headings has been increased from 23 to 29. There are 3 new chapters concerned with Vertebrate History: Introductory, Paleozoic Vertebrates; Mesozoic Vertebrates; Cenozoic Vertebrates. The original 17-page Synoptic Classification of Vertebrates has been trebled in size and now provides a comprehensive list of fossil genera. The critical Bibliography, while not pretending to inclusivness, is excellent. The Index is essentially taxonomic and is most useful as a key to the genera cited in the Classification.

For anthropologists the work will serve as an up-to-date, convenient and authoritative handbook of vertebrate paleontology. Designed to serve as a text, no one topic is treated exhaustively. This is an advantage in many respects and is enhanced by the clarity of the author's style.

The sections of particular interest to the anthropologist are those concerning the Primates and the final chapter in the book dealing with the Cenozoic Vertebrates. In the present edition the chapter on the Primates has been moved up from a terminal position to one which follows Chapter 16 on Primitive Mammals and Chapter 17, Placental Origins; Insectivores; Bats. The Primates followed the chapter on Rodents in the first edition. Certainly from the phylogenetic standpoint the present arrangment is an eminently suitable one.

The section on early human cultures in the chapter on the Primates sets forth a scheme of culture sequence beginning with a Pre-Paleolithic stage and then passes on through Lower, Middle, and Upper Paleolithic stages. This outline is definitely inadequate, even though one admit the necessity for brevity of presentation. It has been outmoded for at least 25 years and conveys little with regard to the reality of culture change during the Pleistocene period. It would be better to retain the chronological divisions of Lower, Middle, and Upper Pleistocene indicating within this framework the prevailing characteristics of the several different Stone Age industrial traditions. On this basis the beginning of the Lower Pleistocene would be characterized by the presence of pebble tools and crudely chipped flake implements and by the appearance of bi-facial tools of the coup-de-poing and cleaver varieties. The Middle Pleistocene might be characterized as the period of the heyday, in the western part of Eurasia and Africa, of the bi-facial tool tradition, while in the Southeast and Far East of Asia occur the chopping tools manufactured without benefit of bi-facial flaking. The Middle Pleistocene also bears witness to the growth of flake-using traditions of several different varieties which in some areas persist throughout the Upper Pleistocene. The Upper Pleistocene is the time of the rise and spread of the blade-using cultures which reach their climax towards the middle of this period, to be followed in general by the pygmy blade industries of the final phases of the Upper Pleistocene, some of them carrying on into the Recent period. It is also the period in which the bi-facial tool tradition of the Lower and Middle Pleistocene withers and dies.

This is unquestionably a more complicated arrangement of the facts than to present ''cultures'' in a series of sucessive ''stages.'' On the other hand, Professor Romer in dealing with the hominids of the Pleistocene follows essentially the suggested type of arrangment and relates them to the subphases of his geological periods rather than to morphological or cultural stages. The principal departure from this scheme is with regard to Neanderthal Man in which the variability of that form in time and space is inadequately emphasized.

The other chapter of major interest to anthropologists is that on the Cenozoic vertebrates. This is arranged chronologically and has with it a useful table, consisting of a world-wide correlation of important fossil-bearing localities. The assignment by Professor Romer of the Villafranchian deposits of the Val d'Arno to the Pleistocene is of special interest in connection with the disputed question of the Plio-Pleistocene boundary. The course and character of human evolution is not so greatly affected by uncertainty as to the geological and palaeontological content of the Pleistocene. But in matters affecting the rate or rates of Hominid evolution and differentiation, a stable definition of the Pleistocene, as to its components and their duration, is fundamental before problems of this kind can be investigated.

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THE SOUTH AFRICAN FOSSIL APE-MEN: THE AUSTRALOPITHECINAE. By R. BROOM AND G. W. H. SCHEPERS. (With a preface by Field Marshall J. C. Smuts.) Transvaal Mus. Mem. no. 2, Pretoria, 272 pp., 18 plates, 1946.

Since the time of its discovery at Taungs, Bechuanaland, in 1924, Australopithecus africanus Dart has been the focus of a prolonged controversy. Some, like Professor Dart, regarded it as allied to the early human line of descent, while others looked upon it as merely a twig of the anthropoid line of evolution having nothing to do with the origin of man. Since 1936, thanks to the farsightedness and energy of the eminent South African paleontologist, Dr. Broom, new material representing remains of both juvenile and adult specimens of nearly related types have come to light. The first type discovered at Sterkfontein in 1936 was first named Australopithecus transvaalensis but was subsequently assigned to a new genus, Plesianthropus transvaalensis. The second type, discovered in the nearby site of Kromdrai in 1938, has been named Paranthropus robustus. Ever since his first discoveries Dr. Broom has been informing the scientific world of the progress of his work and now, in collaboration with Dr. Schepers, he has presented the fuller monograph which has been eagerly awaited.

In the first part, dealing with the skeletal material, Broom describes Australopithecus, Plesianthropus, and Paranthropus, in this order, and then discusses the question of their affinities. Skeletal and dental material is well illustrated, but with the exception of the Australopithecus skull, only drawings and no photographs are given. While no doubt Broom's drawings are good, photographs would be more useful and it is hoped that Dr. Broom will remedy this need in a future publication.

Broom demonstrates that the skulls of Australopithecus, Plesianthropus, and Paranthropus show a mingling of anthropoid and hominid features. He shows also that both the permanent and the deciduous sets of dentition in these fossil types approach closely that of man. However, some points are not discussed, such as (1) the bearing of the well preserved, definitely caniniform lower canine of the male Plesianthropus on the incisiform lower canine of Sinanthropus and on the subsequent course of evolution of the human lower canine, (2) the changes in a grooved secondary ridge between the hypocone and metacone of the upper wisdom teeth; and one or two other points are omitted. Also in some, but not in all, cases instead of giving the length (mesio-distal diameter) and breadth (bucco-lingual diameter) separately, the two are given together, as for instance 10 mm by 8 mm, causing confusion. Nevertheless, in spite of these, on the whole the description of the teeth is quite clear.

Besides the cranial fragments, there are available the distal end of a femur, part of a phalanx, and an os capitatum attributed to Plesianthropus; and the lower end of a humerus, a portion of the upper end of an ulna, some bones of the left hand, two toe bones and a talus attributed to Paranthropus. It is shown that, although there are some differences, they approach the limb bones of the hominids.

Broom gives new reasons for changing the datings of the fossil materials. His evidence primarily centers around a hyaena of the genus Lycyaena and the presence of two sabre-tooth cats ''apparently belonging to the genus Meganthereon'' at Sterkfontein. The remains of Lycyaena, represented by a few teeth of both jaws, were obtained by the eminent prehistorian Abbé Breuil from Dr. H. K. Silberberg, an art dealer in Johannesburg, and presented to Broom. Broom states that the spot where these remains were found by Dr. Silberberg is ''about directly below the spot where the type skull of Plesianthropus was found, but at about 60 feet lower level.'' Thus the remains of Lycyaena come from a lower working, but Dr. Broom states that ''the other specimens I found here did not seem to indicate any difference in age.'' Accordingly, Broom now believes that ''an Upper Pliocene date is more likely for the Sterkfontein ape-man than either Lower or Middle Pleistocene,'' and that the Taungs caves ''must belong to an earlier stage of the Upper Pliocene or even to Middle Pliocene.'' He is inclined to place the Kromdrai deposit in Lower Pleistocene. If these new datings prove to be correct, they will be of paramount significance; but it is apparent that more evidence is needed for a definite determination.

Broom reaches the conclusion that ''it seems no longer possible to doubt that the Australopithecines are nearly related to early man,'' thus further confirming Professor Dart, the original describer of Australopithecus. In this reviewer's opinon this conclusion is well founded, and the Australopithecines are distinctly related to the human line of descent. As is well shown by Broom, they are neither chimpanzees nor pigmy gorillas.

In this new work, Broom departs widely from his previous opinion on the affinities of the anthropoids and hominids. He now believes that the Australopithecines (and the hominids) are derived from a pre-Dryopithecid form and the anthropoids and the Australopithecines-hominids were separated ''probably as early as Lower Oligocene,'' maybe even upper Eocene. Broom now holds that the resemblances between the anthropoids and hominids are due to parallelism. Broom's new view is based mainly on the study of the milk molars. It should be pointed out, however, that our knowledge of the milk teeth of Dryopithecus, Sivapithecus and their relatives is practically nil, and thus a detailed, direct comparison is not possible at the present. In this reviewer's opinion, the mass of evidence is in favor of the view that the great anthropoids and the hominids are closely related, both coming from a late Tertiary common ancestor.

In the second part of the book, Schepers has studied the natural endocranial cast of Australopithecus, three somewhat distorted casts of Plesianthropus and casts prepared from the temporal bone of Paranthropus. The general appearances and proportions, sulcal patterns, cortical areas, contours, endocranial vascular patterns, metric features, neurological significance of the casts are studied in this order and the report ends with a chapter on theory and speculation.

Scheper's study is detailed, illustrated with drawings and photographs, and full of comparisons with the anthropoids. But at the beginning one encounters the following over-enthusiastic statement on the general method employed, which must be taken into account.

> "In all attempts at representing these fossils in a reconstructed form, the method employed was that of claiming the maximum dimensions considered likely for the type. There will be enough sceptics who are unwilling to accept the advanced status of these types and they will insist on claiming the minima only for these fossils. There can be no scientific objection to such extreme scepticism. It is, however, much less satisfactory to hear that a new find of fossil material does not suggest any new hypothesis or does not corroborate evidence already at hand about a cognate theory, than to discover that at least someone is prepared to claim the maximum importance for his discovery. Such enthusiasm encourages criticism and comment, and is therefore to be recommended"!!!!!

These endocasts show a number of morphological advances over those of the anthropoid brains and in these respects approach the hominids. Schepers, contrary to the opinion of Dart, infers that these forms had acquired articulate speech. Estimates on the volumes of the endocasts are as follow: Plesianthropus I, 435 cm^3; Plesianthropus II, 560 cm^3; Australopithecus (juvenile), 500 cm^3; and Paranthropus, 650 cm^3. However, the last is too fragmentary for an exact determination and this must be kept in mind in studying the reconstructed contours of the cast of this form. Also the body size of the Australopithecines was, as far as we know, smaller than that of a Gorilla and "the Kromdrai anthropoid-like type was . . . not more than 100 lbs. in weight, probably weighing 80 lbs. "This would indicate that the relative brain volume of the Australopithecines was in advance of that of the existing great anthropoids, and in this respect approached the hominids.

This book will be of great value to those interested in the study of the early phases of human evolution and it is hoped that the good work started will be continued, as these deposits appear to be very rich.

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THE HUMAN FRONTIER. By ROGER J. WILLIAMS. Harcourt, Brace and Co., New York, viii + 314 pp., references, index, 1946. ($3.00).

The pressing problem of social science, Williams submits, is to gain knowledge of the human body which will be useful for improving man's life in society. The piecemeal study of the person is not sufficient to attain this end and neither is the analysis of that statistical abstraction, the ''average'' man. Rather we need a basic new science which will consider the human being in his entirety and will not neglect to attend to the *differences* existing between people. ''Scientific study which has for its purpose the improvement of social behavior must understand these differences, seek out their origins, and finally develop the means whereby we can adjust ourselves to them.'' For the applied science of man outlined in this volume the author proposes the name ''humanics.''

Following the presentation of the problem and having introduced his proposed solution, Williams proceeds to gather from the specialized sciences facts upon which humanics may be based. Thus: The basic source of human energy is metabolism; individuals differ in ''metabolic patterns,'' and ''probably upon these fundamental metabolic differences . . . our observable individual differences rest.'' Nowhere is evidence presented tending to show that cultural conditioning may influence metabolism. Individual variation in sensory processes (vision, appreciation of design, musical taste, fatigability, olfaction, etc.) are next discussed with similarly no attention paid to the question whether these may be to some extent socially patterned. The assumption holds that most individual traits rest upon innate factors, an important point for the author's thesis which affirms that because such variations are found between people we must ''order affairs more and more so that each individual can feel at home in a society that has at least made a sincere effort to adapt itself to his distinctive capabilities and needs.'' Psychological traits are discussed in the same frame of reference. What develops in the reader halfway through the book is a sound appreciation of individual differences together with the awareness that all of the facts of interpersonal variability are not yet known. A normative statement indicates what the author expects from an understanding of the facts which he has just presented. ''No matter what the activity is, it should be society's goal to provide for the variability which exists in that activity.'' Such provision must come through tolerance based on knowledge of how people vary. Perhaps the fundamental objection to be raised at this point is to note that the author has neglected to analyze the causes and range of the trait of intolerance in society. The second half of the book is largely devoted to a discussion of humanics to marriage, criminology, education, and medicine.

Thoughtful readers will agree with William's argument for tolerance based on understanding of human variability. It nevertheless remains naive to suppose that a scientific clearing house like humanics will magically realize this goal. Physical anthropologists have learned the slowness with which truths about race become disseminated; cultural anthropologists know that cultural tolerance does not bloom overnight. Williams' aim to broadcast knowledge of physiological and psychological variability appears philosophically sound but his conclusions often remain arguable because of his failure to estimate the role of social determinants.

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AN INTRODUCTION TO PHYSICAL ANTHROPOLOGY. By M. F. Ashley Montagu. Charles C. Thomas, Springfield, Ill., xiv + 326 pp., 25 figures, 6 tables, appendix, bibliography and index, 1945. ($4.00)

The challenge and the opportunity have been present for many years to write an introductory textbook in the field of human biology as considered by the physical anthropologist. The intent of Professor Montagu's book is to meet this challenge and to take advantage of this opportunity. That it fails in both respects is a matter for general regret. A short but comprehensive introductory text is still needed. The growing interest in physical anthropology in an increasing number of universities and colleges throughout the United States justifies the time and attention which should be given to the production of a primer in physical anthropology.

A textbook which is written with a central theme and with an expression of the basic philosophy of the subject being treated is of definite value, even though it may contain factual errors. When a book contains an inconceivably large number of factual errors, expresses no general philosophy and follows clearly no central theme, it is both unusable and harmful. The work here reviewed is an example of these deficiencies. Particularly is this true when its special purpose is taken into consideration. That purpose is obviously not to instruct the author's fellow professionals. The book is, presumably, to be used with students who are receiving an introduction to the data and the viewpoints of that part of anthropology which is chiefly concerned with man as a biological organism.

The author has a lively style, the size, scheme and price are right for a text. The idea of following each chapter with a critically annotated bibliography is, in my view, a sound pedagogial procedure. All these are genuine merits. Hence it is with reluctance that I turn to the less meritorious aspects involved in the depressingly large number of factual errors, errors which decrease its value from the viewpoint of a teacher using it as a text. The selection which follows is random and not systematic although it starts toward the beginning of the book and progresses toward the back. Matters of opinion have been avoided in the main, such as my own preference for using the name Gigantopithecus rather than Gigantanthropus until the status of that Primate has been settled beyond reasonable question.

In the chapter on "The Primates as a Zoological Group" the error in the definition of the terms "Platyrrhini" and "Catarrhini" is an elementary one which consulation of any unabridged dictionary would have precluded. They further stand in contradiction to the amplified statement on page 13. For an author who has written a number of papers on the higher primates and who has dealt at length with the "Tarsian Hypothesis and the Descent of Man" the error in the dental formula of Tarius is very strange. So too is the statement that the tympanic annulus has migrated outside the auditory meatus, when a sounder explanation is that it follows the Catarrhine form of having been converted into a tubular meatus. On page 41 the male gorilla is credited with an average cranial capacity of 550 cm^3 and the female 460 cm^3, while on page 68 the gorilla is stated to have an average capacity of 470 cm^3.

The statement on page 74 in the chapter on "The Origin and Evolution of Man" that the stone tools found in the Trinil beds, and often assumed to be the handiwork of Pithecanthropus, are similar to the artifacts found with Sinanthropus is not supported by any published evidence known to the reviewer. The Patjitanian assemblage of Lower Paleolithic facies is best known from its occurrence in the Basoka drainage system of Java. There is as yet no provable association with any of the variant forms of Pithecanthropus, and while part of it does resemble the Early Anyathian of Burma, its resemblances to the industry of Choukoutien are minimal.

A most curious error has been made with regard to figure 13, which purports to show the sagittal craniogram of "The Grimaldi" compared with that of the Neanderthal skull of La Chapelle-aux-Saints. It is placed in juxtaposition with the section of this chapter which deals with Grimaldi Man and the reader is therefore led to believe that the craniogram represents either the youth or the woman found in the lower part of the deposits of the Grotte des Enfants. The craniogram is that of the very tall male individual found at the 7-meter level and usually considered to be a fairly characteristic representative of the Cro Magnon type.

The chapter on "The Criteria and Mechanism of Ethnic Group Differentiation" is largely concerned with subjects which Montagu has discussed at length in numerous papers and notably in his book "Man's Most Dangerous Myth." Of the errors of fact, one relates to the discussion concerning the letter designations of gene frequencies for the blood groups. On page 129 the gene frequency symbol for the A group is said to be denoted by the letter *p*. On the following page the same statement is made with regard to the B group. Of course *q* should be read as the symbol for the B blood group gene frequency. Most of the material in this chapter (V) is presented as an example of what anthropologists can do in calculating gene frequencies, yet no statement is made that the method which is described is only applicable to populations in genetic equilibrium. Montagu says unequivocally that "by . . . the gene frequency method it is now possible to calculate the number of genes present in a given population for any character whose frequency in that population and mode of inheritance is known." There can be, of course, no possible difference of opinion with regard to the general tenor of this statement, but nowhere is it made clear exactly how the anthropologist or any other kind of biologist goes about the business of isolating a particular gene and determining its mode of inheritance.

On page 134 is the statement that the blood groups of prehistoric populations may now be ascertained by tests carried out on their skeletal or mummified remains. This naturally would lead the student to expect that only sloth on the part of anthropologists is responsible for the fact that we do not know and of course never will know whether Pithecanthropus or Piltdown or Neanderthal Man possessed blood groups and of what kinds.

The section entitled "The Function of the Blood Group Genes as Gene Indicators" has a summary table on page 137 in which are listed the concentrations of the three blood group factors in various groups of mankind with explicit indications as to the derivation and relationships of some of the major groups of man. The Ainu, the northern Chinese, Malays, Asiatic Turks and Finns and the eastern and central Europeans all derive their group B from the central Asiatic Mongol (Buriat and Kalmuck type). The student then turns the page and reads in the concluding paragraph of this section that "It has already been said that our knowledge of the distribution of the blood groups throughout the world is at present insufficient to permit us to reconstruct the relationship of the divisions and ethnic groups of man to one another." Again, no one can possibly take exception to this latter statement, but it does raise some question as to the wisdom of including in tabular form what purports to be a series of relationships between the divisions and ethnic groups of man.

Chapter VI is concerned with "The Divisions and Ethnic Groups of Man." The author states that his ". . . classification represents an attempt to reduce the classificatory schemes of the older school of anthropologists to a single, simpler scheme . . ." He indicates, however, that he regards even this classification as a highly debatable one.

The classification which follows is certainly debatable. If this represents what Montagu thinks is worth presenting to students, one can well understand his repeatedly expressed disgust with the part of physical anthropology which has overstressed classification. The classification of African Negroids is a paraphrase of Seligman's, which was inadequate when it was written and which has not been improved by this reworking. One grouping which he takes over from Seligman is that of the Half-Hamites, who are described as "the result of a mixture of Hamite with Negro." There is no definition and no explanation of what a Hamite is, because this category does not appear in the section devoted to the Caucasoid division. In passing, it may be noted that on page 165 the term in increasing use for the Hottentot-Bushman people should be spelled "Khoisan." The archaic Caucasoid subdivision (Australoid) includes among others the Pre-Dravidians of central and southern India. This will inevitably puzzle the student, because there is no description or statement of what a Dravidian is supposed to be or the affinities of this group. The predominantly Caucasoid peoples of India are simply labelled "East Indians" and are stated to be basically Mediterranean. The worst treatment is accorded the Mongoloid division in which three main strains are distinguished, the Paleoasiatic, the Neoasiatic, and the Indonesian-Malay. The Paleoasiatic group contains the older populations of Siberia, the Eskimo and the Indians of the Americas. In the section devoted to the American Indian one is given a description of "the ideal type of the American Indian —." Hrdlička never attempted anything as simplistic as this. In describing this ideal type the Eskimo is treated as essentially a variant. The text devoted to the Neoasiatics runs to a little less than 3½ lines, and we find the Eskimo are also included among the Neoasiatics. Then there is a very brief paragraph with regard to the Indonesian-Malay grouping of the Mongoloid division. The chapter concludes with a tabular presentation of the divisions and ethnic groups of man. Under the Mongoloid division we find listed only two major groupings, Paleoasiatics and Neoasiatics, and here the Eskimo pop up again among the Paleoasiatics, while the Chukchee of Siberia appear as one of the ethnic groups of the Neoasiatics and in this same grouping we find listed the Igorot, Indonesian and Malay. It would seem a somewhat elementary matter that if one goes in for classification of any sort, consistency is a desirable feature.

Among the many curious and arresting passages in this work are some which are included in the chapter on "The Relation Between Body, Mind, and Culture." The very brief recapitulation on pages 217 and 218 of the pre-Roman culture history of the British Isles is an outstanding example of the offhand and mis-leading sort of thing which characterizes this section. We are informed that 5,000 years ago, "The ancestors of the modern Englishman were living in a Stone Age phase of culture, painting their bodies with woad, practising all sorts of primitive rites, being culturally about equivalent to the Australian aboriginal — a state in which they continued for more than three thousand years, until their discovery, and conquest, by the Romans in the first century of our era." This is simple rubbish as even a passing acquaintance with, say, Childe's "Prehistoric Communities of the British Isles" would have made plain. Further on we are informed that the African kingdoms and the Babylonian Empire were at their height when Europe was inhabited by hordes of savages, "— and it is probable that the kingdoms of Africa have undergone comparatively little change; —" This is one of those tantalizing assertions which Ashley Montagu throws in without fuller explanation. What parts of Africa were the seat of these kingdoms (plural) of 5,000 years ago? Egypt, of course, comes to mind, and while its interests and activities were primarily dominated by a long-standing ethnocentrism, it did participate in the wider sphere of the eastern Mediterranean; its position in what we denominate as Africa is due to our conventional frame of geographic reference.

Many of the defects noted above are due to carelessness. This is inexcusable in an introductory textbook. Whether one likes it or not, the greater number of undergraduate students are literal-minded. The penalty for forgetting this, in the present instance, is to have produced an unusable book.

The eighteen page appendix entitled "A Practical Synopsis of Methods of Measurement in Physical Anthropology" is controversial. This is not because there is an accepted canon as to how many measurements and what particular ones are essential, but because the student has previously been instructed on page 156 that "The older school of physical anthropologists utilized a purely arbitrary selection of external or phenotypical characters in order to make their classification," and the same idea is expressed repeatedly at intervals throughout the book. This thesis is partly true; there was and still is arbitrariness in anthropometry. Not a few however, of the characters used by the "older school" were believed, sometimes wrongly, to possess phylogenetic significance. A critically minded student is hard put to understand why the particular 33 bodily measurements, the 16 measurements on the head and face and the 10 indices which are presented to him are any less arbitrary than the characters used by Broca or Sergi, Deniker or Beddoe. The student is told in the Introduction (page 5) that to the physical anthropologist the "Question of questions" is "what are the causes which produced, and continue to produce, man in all his infinite variety?" Yet no attempt is made to relate anthropometry or anthroposcopy to this search for causes.

The lack of integration around a theme or themes illustrated in the preceeding paragraph is a central defect. The problem is not that the author is theme-less but that the central idea, the causes behind human variation, is too grandiose for an introductory text. So much of physical anthropology, like so much of biology, has been and still is descriptive; we can to some extent "— draw up a reasonably reliable history of the origin and evolution of the human race, and all its varieties —" (p. 5) but causes will continue to be inferences resulting from a judicious weighting of probabilities. The beginner needs to be told what we know, and have that quite distinctly set apart from what we think it means; of being made fully cognizant that the interests of most physical anthropologists have been or still are devoted to the study of hominid phylogeny, a subject which is related to the investigation of the biodynamics of living populations but not co-extensive with it; that the methodology of the former is only in small part applicable to the latter. Lacking this conceptual frame of reference, physical anthropology will go on failing to make sense, as it does in the book here reviewed.

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INDIANS BEFORE COLUMBUS. TWENTY THOUSAND YEARS OF NORTH AMERICAN HISTORY REVEALED BY ARCHAEOLOGY. By Paul S. Martin, George I. Quimby, and Donald Collier. The University of Chicago Press, xxiii + 582 pp, 122 text illustrations, 1947 ($6.00).

This is a handsome and useful reference book in archaeology, and any physical anthropologist concerned with the American Indian will be glad to have it. He will probably be annoyed, however, at the paste-and-scissors treatment accorded physical and racial types, because it does not yield a connected interpretation and certainly is not based on one. In the only general discussion, in the introduction, the Indians are presented in a version of Hooton's hypothesis, as a general proto-Mongoloid stock, of which some immigrant groups were admixed with Mediterranean White and Oceanic Negro. (The ancient or possibly ancient skeletons are not considered here.) Types are then described in the text area by area. In the Southwest, all known Indians belonged to the "Southwest Plateau" Indian stock, having heads which varied from short and broad to long and narrow, and faces which varied similarly. In the eastern United States they become Sylvids, Centralids, Pacifids and Prairids, each type being fairly specific in form but mixing and influencing one another extensively. In the Plateau and on the Northwest Coast Indians were simply round-headed folk, of medium stature, while the people of the Arctic are described physically only as "Relatively long-headed Eskimos," "Relatively broad-headed Eskimos," or "Several varieties of long-headed or medium-headed Eskimos" (for the Birnirk, Post-Punuk and Thule cultures respectively). Among the Aleuts, however, Pacifids turn up again.

This unsystematic jumping around makes physical anthropology seem baffling to beginners and silly to students in other fields. It does not reward the reader with either a final synthesis or an easy descriptive method. The authors might have done better by following Dixon's "Racial History"; at least that book employed a single form of description, and endeavored to make the North American racial variations intelligible as a whole.

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Navaho Physical Types.— There is by no means a single Navaho type. The fact that about 20 of the Navaho clans are said to have been started by non-Navaho ancestresses is at least symbolic of historical truth. It is certain that during the last few centuries, and probably earlier also, The People have absorbed large numbers from other tribes. Not inconsequential amounts of white blood are also present, much of it dating back to the seventeenth and eighteenth centuries, when the children of Navaho women who had been captured and kept as slaves by the Spanish escaped and returned to the tribe. Some white blood has come indirectly through the Pueblos, and since the establishment of the Reservation [1868] some white traders have left various progeny with and without benefit of wedlock. Even Navahos who are known to have a White father, however, think of and refer to themselves as Navahos.

. . . In a general way, one may say that there are 2 principal Navaho types: the shorter, stockier "Puebloid" type and the taller, leaner, longer-faced, more frequently moustached, raw-boned "Tuba City" type.— Clyde Kluckhohn and Dorothea Leighton. *The Navaho.* Harvard Univ. Press, 1947, xx + 258 pp.

Body-Typing in Physical Education.— The future of measurement in physical education will undoubtedly be identified closely with body-typing. Such typing should more and more become the basis of norms for almost every kind of physical fitness test, if the results of tests are to be properly interpreted. This is true, for example, with the determination of nutritional status . . . , a problem that has already become an area of study for recent experimenters in this field. In considering somatotypes as related to age-height-weight tables, the endomorph is normally overweight, the mesomorph is nearer average, and the ectomorph is well below these standards. Yet, if based upon weight tables alone, they are all judged alike . . .

The rate of physiological sexual maturation, at least in females, can be better understood in relation to the individual's somatotype. From studies so far conducted, it seems apparent that dominance of the ectomorphic component tends to postpone sexual maturation, as indicated by appearance of the menses, and a modest predominance of either of the endomorphic or mesomorphic components tends to hasten it. On the other hand, a strong predominance of either of the latter components alone tends, in the female, to suppress sexual development altogether.— H. Harrison Clarke. *The application of measurement to health and physical education.* Prentice-Hall, Inc., N. Y., 1945, xvi + 415 pp. ($5.00).

SOME PARTICULARS OF SKULL AND BRAIN OF EARLY HOMINIDS AND THEIR BEARING ON THE PROBLEM OF THE RELATIONSHIP BETWEEN MAN AND ANTHROPOIDS

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EIGHT TEXT FIGURES AND FOUR PLATES

The fossil human material of Java, particularly the series of Homo soloensis skulls from Ngandoeng brought to this country by Dr. G. H. R. von Koenigswald, will widen our knowledge of early man in an unexpected way. The first note on the Ngandoeng series, published by Oppenoorth ('32), stressed their special character in such a reserved manner that the skulls were generally regarded as Neanderthal specimens, noteworthy only for the unusually distant place from which they came. In a later article Oppenoorth ('37) made the situation still worse by claiming that Homo soloensis is not even a Neanderthal but a more modern human type close to the Wadjak man. No wonder that in face of these contradictory statements and obvious misrepresentations the skulls never attracted the careful observation or attention they deserved, either in Holland itself or elsewhere. This neglect was certainly the result of Eugène Dubois' ('40) attitude. He even risked his scientific reputation in his endeavor to minimize Homo soloensis for the sole purpose of stretching the morphological distance between "his" Pithecanthropus and any other hominids.

When in 1938 I had the chance to glance over the originals in Java, I was impressed by the many primitive structures

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exhibited by the skulls despite the insufficiency of their preparation. I recognized that they have rather to be ranged with Pithecanthropus than with the classic Neanderthalians (cf. my remarks on the skulls, '43). More thorough preparation and examination of the originals in which I am now engaged brought additional primitive features to light so that my ranking Homo soloensis with the Archanthropinae ('45) stands against any doubt. I shall deal with the morphology of Homo soloensis in a special monograph, yet his momentous bearing on the general problem of human evolution and differentiation justifies the selection of some of his most remarkable characteristics for discussion in this preliminary note.

The special features I have selected are only recognizable when the basilar part of the skull is preserved and the cranial cavity is accessible. So far very few fossil human skulls have proffered this opportunity. This is apparently the reason why the features in question have almost completely escaped attention, or, if recognized, their interpretation has been questionable.

I. THE SYLVIAN DEPRESSION AND THE SYLVIAN CREST

In describing the cerebral surface of the Sinanthropus skull ('43) I called attention to a strong, high ridge that arises from the sphenoid angle of the parietal bone and runs upward and backward toward its center. Schwalbe ('02, '07) noted the occasional occurrence of this structure in modern man and named the ridge "crista Sylvii." However the credit for its discovery goes to G. Zoja who described it first in 1894. He found it enormously developed in a very thick and robust, recent human skull. According to the author, the ridge represents the continuation of the edge of the lesser wing of the sphenoid that runs out toward the parietal bone. Zoja named the structure "cresta endofrontale" or "endopterica." In addition he mentioned a depression anterior to the crest itself — "fossetta endofrontale laterale" — which lodges the inferior part of Broca's inferior frontal convolution. Schwalbe stated the coincidence of the crest with the Sylvian fissure. In other words, he recognized that the ridge plays the role of a "jugum cerebrale." However, the question of to what degree its development affects the pattern of the cerebral surface of the Sylvian area did not arouse his interest.

Since a pronounced Sylvian jugum is a rare occurrence in modern man, the correlation between the degree of its development and the width and extension of the Sylvian fissure escaped attention. When I studied the endocranial casts of Sinanthropus, the configuration of the temporal lobe aroused my attention. In all cases in which the temporal lobe is preserved, the part next to the parietal lobe is depressed and this depression extends to the parietal lobe (plate 1, fig. 1). Where the 2 lobes join the frontal lobe, the depression reaches its maximum. I mentioned the "lowness" of the temporal lobe in my paper dealing with the development of the hominid brain ('39) and said: "It is difficult to determine whether the lowness of the temporal lobe must be considered a real underdevelopment or a different configuration of the lobe due to the special width of the temporo-cerebellar notch." Shellshear and G. Elliot Smith described the temporal region of the endocasts of Sinanthropus Skull III (Black's Skull E) as narrow, and the temporal pole as long and slender, passing forward and inward under the precentral region. The authors also refer to G. Elliot Smith's study of the endocast of the Rhodesian Skull (see below) in which he emphasized the importance of the "expansion of the parietal region immediately behind the posterior end of the fissure of Sylvius which expresses itself in the form of a rounded elevation of the surface." They state, furthermore, that "the corresponding expansion in the cast of Sinanthropus forms a prominent feature and is related to the parallel sulcus where it turns upward to pass round the posterior end of the fissure of Sylvius." According to the authors, there is a "localized projection of the posterior end of the second temporal convolution" immediately in front of the "inferior parietal expansion which continues around the end of the Sylvian fissure to the temporal lobe.''

It is obvious, and corroborated by G. Elliot Smith's illustrations, that the ''expansion'' of the parietal and temporal region located around the Sylvian fissure is in reality not as much a projection above the general level of the surface of the endocast as an accentuated border around the depression of the Sylvian area (cf. plate 1, fig. 1). The Sylvian depression is a characteristic feature of the Sinanthropus endocasts; it is shown in skulls III, V, XI and XII. But it is also very distinct in Pithecanthropus skull II, (plate 1, fig. 2), although the parts at the frontal end of the fissure are not preserved here. Shellshear and G. Elliot Smith draw far-reaching conclusions from the development of the temporal boss in the Rhodesian and Sinanthropus endocasts. They say: ''This feature is of special interest because it corresponds to a region in a modern human brain, injury to which is associated with inability to understand spoken language. Its precocious appearance in the endocranial casts of Sinanthropus and other early human types, such as Eoanthropus and Pithecanthropus, raises the possibility that the earliest men may already have acquired the power of speech.'' Some lines before, the authors claim that eminences like that in the parietal region (P) indicate a precocious expansion of the cortical area. In other words, their existence is the result of an active expansion taking place in a strictly localized area. I regard the formation of the eminences a passive process caused by underdevelopment of the adjoining portion of the brain. At first glance this difference may appear irrelevant or a sophistic interpretation, but it is not as the following evidence will show.

One of the most conspicuous characteristics of the Sinanthropus skull is the form of the braincase when looked at from the rear. Contrary to conditions in modern man, the ''euryon,'' landmark of the greatest breadth, is located near the base of the skull on the temporal squama above the ''auriculare.'' Below and above their level, the coronal craniogram bends sharply inwards while in modern man the contour runs vertically below that level and turns outward above it (cf. figs. 52, 58, 64, 70, 76, 82 and anterior coronal craniograms, figs. 192–194 in Weidenreich, '43). The parietal and temporal eminences of the endocasts described by Shellshear and G. Elliot Smith coincide with the turning point of the coronal craniogram. In other words, compared with the full endocast and brain of modern man, the endocast of Sinanthropus shows a remarkable deficiency in the lower parietal and upper temporal regions. The brain of Sinanthropus is, in general, less developed than that of modern man. This underdevelopment concerns all parts of the brain but particularly the ones just mentioned. In an earlier paper ('36) I was able to show that the expansion of the pallium involves, above all, the posterior parts of the parietal and temporal lobes (cf. fig. 20, Weidenreich, '39). They gain most from the enlargement of the brain. If the brain is filled up as it is in modern man, the deficient areas become levelled up with the P and T prominences (cf. plate 1, figs. 1 and 3) so that the latter disappear as special projections. In Pithecanthropus the conditions are the same as in Sinanthropus and therefore do not need special description and explanation.[1]

The depression of the Sinanthropus and Pithecanthropus endocasts at the Sylvian area owes its existence to the same factors which render nonexistent the differences of level in the preceding case, only here the original conditions are reversed. I found the clue to the solution of the problem when I studied the endocasts of Homo soloensis. This is not the place to tell the whole story about the Homo soloensis skulls, but I would like to refer my readers to a paper on this subject by Dr. von Koenigswald and myself which is now in preparation. Here I merely want to stress that without opening the skulls it has been possible to make endocasts of skulls VI and XI after the matrix which still adhered to both the outside and inside of the basilar parts was removed. These 2 skulls are exceptional in many ways. First, the entire base is preserved except for the roofs of the 2 orbits and the ethmoidal region between them in skull XI; second the skulls are the only fossil human skulls so far recovered in which almost all essential structures of the base are distinctly recognizable in detail; third the Soloensis skulls are not ''Neanderthalians'' in their morphological character as was first suggested, but come much closer to the Pithecanthropus group, and fourth, they exceed all human skulls in massiveness and robustness and also partly in size. This primitiveness combined with a perfect condition of preservation makes the skulls unique objects of research.

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[1] Ariëns Kappers and Bouman ('39) have described the endocast of Pithecanthropus skull II, but the characteristic depression of the Sylvian region completely escaped their attention. From the fissural system of the frontal lobe and the differences in the size, they only conclude that Sinanthropus is more human than Pithecanthropus. Earlier, Shellshear and G. Elliot Smith ('34) arrived at the opposite conclusion.

The endocasts together with a cast of the cerebral surface of the basilar parts, revealed a great many astonishing details. Some of them will be described below. I expected them to show conditions of the Sylvian region similar to those of Pithecanthropus and Sinanthropus with whom they share so many primitive characters, but to my surprise, I did not find anything of this kind. Instead, that region of the endocasts looks like any of the typical Neanderthalians, that is to say, frontal, parietal and temporal opercula meet each other. Plate 1, figure 3 presents a lateral view of the endocast of Homo soloensis skull VI. Only the area of the frontal crania (cf) has been restored. There is no deficiency at the basilar part, but the matrix adhering to the floor of the fossa cranii anterior could not be completely removed. The temporal lobe (lt) and the parietal lobe (lp) are fully developed at the critical area. There is no indication of a Sylvian depression. On the contrary, the temporal lobe seems to extend much farther forward at the expense of the frontal lobe which appears, on the whole, much shorter in relation to the size of the brain than in Pithecanthropus (plate 1, fig. 2) and Sinanthropus (plate 1, fig. 1). The frontal operculum (of) projects, however, to the same extent as in the specimens just mentioned. That this filling up of the endocast is not due to an adherence of unremoved matrix but can be caused only by the expansion of the brain itself, is evidenced by the meningeal vessels at the surface of the endocast which otherwise would not be recognizable. Since all the endocasts of Homo soloensis in which the Sylvian region is preserved reveal the same conditions as skull VI, it is obvious that we are dealing here with a general character of the brain and not with an accidental individual variation. This indicates that the Homo soloensis brain comes closer to that of modern man in this regard than do Pithecanthropus and Sinanthropus, although the absence of the hump at the vertex and the general flatness of the brain reveal a non-neoantropic character. In other words, the original deficiency of the brain of early hominids in the Sylvian region has already disappeared in Homo soloensis.

This leads us to the question, which parts of the brain are not developed in the Sylvian region of Pithecanthropus and Sinanthropus but are developed in Homo soloensis. As mentioned above, G. Elliot Smith first described a brain deficiency of this kind in the Rhodesian skull (plate 2, fig. 1). According to him, this deficiency is restricted to the area marked by the letter S in plate 2, figure 1, exactly where the temporal lobe turns away from the frontal and parietal lobes. Compared with modern man, this deficiency indicates ''a greater extent and depth of this depression'' and it suggests that the Sylvian fissure was ''open'' to the extent marked by the letter S. G. Elliot Smith did not recognize that in reality this deficiency covers a much greater area than his area S and extends from there upward and backward to P, and downward and backward to T, as described above.

The entire depressed areas as shown in the endocasts of Pithecanthropus, Sinanthropus and Rhodesian skulls (plate 1, figs. 1, 2, and plate 2, fig. 1) correspond not merely to the indentation of the Sylvian fissures, but to the adjoining lobal parts of the brain as well. But this is exactly the spot where the island of Reil is located. Plate 2, figure 2, which is copied from Spitzka's edition of Gray's Anatomy (fig. 683, p. 926; '13), shows the island of Reil in its original position beneath the surface and the frontal, parietal and temporal opercular convolutions which normally cover it. The deficiency in the early hominid brains mentioned before can be caused by either of 2 phenomena: either the island itself is not developed to the same extent as it is in modern man and therefore the covering cortex parts are sunken correspondingly, or the island is fully developed but the opercular portions of the cortex have lagged behind in development. The first alternative is very unlikely for the island represents the oldest surface of the mammalian pallium, becoming gradually overlapped by the 3 lobes which develop later (cf. E. Landau, '40) and cover the island completely. In the ontogenetic development of the human brain, the definitive stage will be reached at the time of birth. Foetuses of the ninth month show the island only partly covered because of the underdevelopment of the opercular convolutions, especially those of the parietal lobe, as shown in plate 2, figure 3, a copy taken from G. Retzius. Even in the new born infant, the covering of the island is not completed. Due to unknown conditions the Sylvian fissure remains "open" occasionally even in adult man. By the courtesy of Father C. J. Connolly I have been permitted to make use of an observation of his which will be described in his forthcoming comparative studies on the convolutional and fissural pattern of the brain of man, anthropoid and other primates. In that special case, the endocast shows a depression at the Sylvian area and the corresponding brain reveals an "open" Sylvian fissure when viewed from in front.

It can be inferred from all these facts that in early hominids the brain exhibits late fetal conditions, the opercular portions of the frontal parietal and temporal lobes not completely covering the island of Reil. In the Neanderthalians this covering is perfect except for the Rhodesian skull, while Homo soloensis, despite his very primitive character in other features already displays the more advanced Neanderthal pattern.

This report would not be complete unless the conditions in anthropoids were taken into account. A priori, one might expect that the endocasts of anthropoids might reveal a still more depressed Sylvian area than the hominids and their brain might show a corresponding open fissure. But just the opposite is true. It is a characteristic feature of the endocasts of all 3 anthropoids that there is no indentation where the frontal and temporal lobes meet, neither is there any depression in the entire Sylvian area (fig. 1). On the contrary, the opercular portion of the parietal lobe, together with the same portion of the temporal lobe form a single prominence. This corresponds entirely to the conditions of the brain. In all well preserved brains of anthropoids, in particular those which have been preserved in situ before they were taken from the cranial cavity, the frontal, parietal and temporal lobes are so tightly pressed against each other that the Sylvian fissure does not appear wider than any other fissure (fig. 2). This is a characteristic difference between early hominids on one side, and anthropoids on the other. The brain of the latter is not merely smaller in general than that of man, but it differs also in its special shaping. The deficiency in the Sylvian area which the brain of early man exhibits is not a "simian" character and as such taken over from anthropoids, but seems to be primarily a specifically human one.

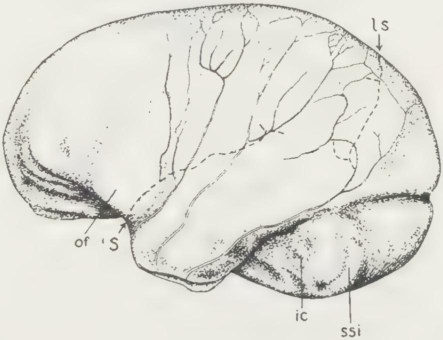

Fig. 1 Left lateral view of the endocranial cast of an adult male chimpanzee. × ½. ic, incisura temporo-cerebellaris; ls, sulcus lunatus; of, operculum frontale; S, Sylvian fissure; ssi, sulcus sigmoideus (sinus transversus).

The groove of the endocasts of early man which indicate the beginning of the Sylvian fissure and the adjoining depressed area, appears as a long, obtuse "jugum cerebrale" which projects from a relatively broad base at the cerebral surface of the sphenoid angle of the parietal bone. This is nothing other than Zoja's "cresta endopterica" or Schwalbe's "crista Sylvii." Indeed, this crest is well developed in all Sinanthropus skulls. The cerebral side of the temporal fragment of Sinanthropus skull V (fig. 3) and the endocast of the

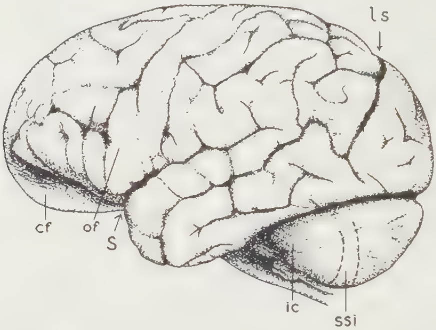

Fig. 2 Left lateral view of the brain of the same chimpanzee as shown in figure 1. The brain was hardened by injection into the artery before the cranial cavity was opened and the brain taken out. × ½. Abbreviations same in figure 1. cf, carina frontalis.

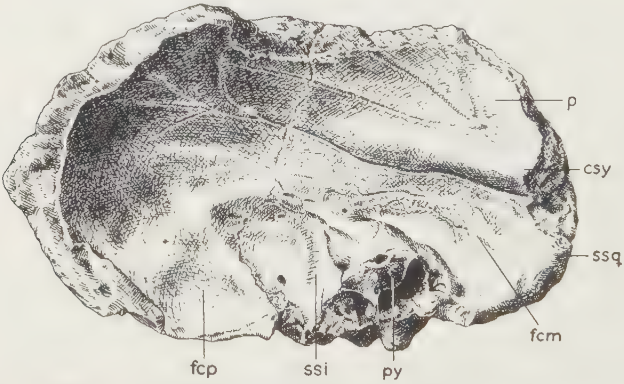

Fig. 3 Cerebral side of the temporal fragment of Sinanthropus skull V, showing the Sylvian crest. × ½. fcm, fossa cranii media; fcp, fossa cranii posterior; py, pyramid; ssi, sulcus sigmoideus; ssq, sutura spheno-squamosa.

same fragment (fig. 4) are depicted as examples. The pictures show the far projecting, broad-based Sylvian crest (fig. 3, csy), which must appear in the endocasts as a corresponding depression (fig. 4). In Pithecanthropus skull II, the Sylvian jugum is also well developed while there are none in any of the Homo soloensis skulls. Whether or not a heavy crest is developed in the Rhodesian skull is unknown. Pycraft states only that "the orbito-sphenoid wing, instead of forming an extensive overhanging ledge, projects backwards over the middle fossa but very slightly." What this means, only an examination of the original can reveal.

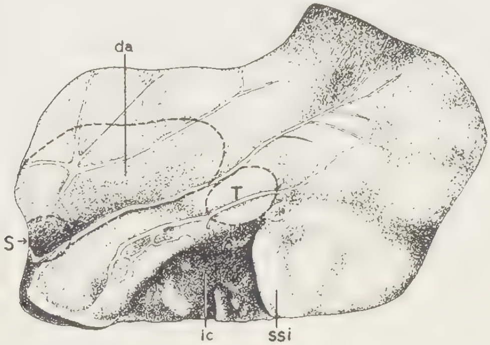

Fig. 4 Endocranial cast of the temporal fragment of Sinanthropus skull V, as shown in figure 3. × ½.

Before the phylogenetic side of the whole problem can be regarded, the question arises whether the crest brings about the depression of the brain or the depression of the brain produces the crest. It admits of no doubt that the latter alternative is true. This is not the place to enter into a detailed discussion of the whole problem; it will be done elsewhere. However, all that is known of the "impressiones digitatae" and the "juga cerebralia" and their relations to the convolutions and sulci, suggest that the formation of the convolutions hamper the apposition of bony substance at the cerebral surface at the tabula interna of the cranial wall while the presence of sulci on the cerebral surface stimulates such an apposition.

Bone generally grows in the direction from which there is the least resistance, therefore bulging of the cerebral surface or the dura mater prevents apposition and produces an impression at the surface of the wall when the bone is going to deposit new layers. On the other hand, the less the dura mater projects, the greater the amount of apposition of bone.

It can be deduced from these facts that deficiency of the brain in early hominids is the primary factor and formation of the Sylvian crest is secondary. This corresponds to the structural conditions of the braincase. As I have shown in earlier papers, the greatest breadth of the braincase, in Pithecanthropus as well as in Sinanthropus is located near its base and the breadth decreases gradually toward the top. In modern man, the greatest breadth is found at the horizontal level of the squamosal suture or above the suture. In Homo soloensis the breadth of the braincase comes closer to modern conditions insofar as the decrease of the breadth toward the top is less abrupt than it is in Sinanthropus. The shape of the endocasts reflects this character of the bony case. In early hominids, including Homo soloensis, the endocasts bulge most in the "T" area of the temporal lobe (see above and plate 1, figs. 1 and 2, and plate 2, fig. 1) and decrease in bulging upwards toward the parietal lobe. In modern man, the lower part of the parietal lobe bulges to the same extent as the temporal lobe, or even more. In Homo soloensis (plate 1, fig. 3) the bulging of the area of the parietal lobe is still less than that of the temporal lobe. If there is, nevertheless, no depression in the Sylvian area of Homo soloensis this can only mean that no crest has been developed. This is indeed the case. In Homo soloensis and in Neanderthal man the crest has already disappeared. If it reappears occasionally in modern man, it indicates a minor development of the opercular region of the brain.

In anthropoids there is is general no Sylvian crest. As noted above, this crest represents the ledge formed by the lesser wing of the sphenoid, jutting out toward the fossa crania media. Usually this ledge ends where the lesser wing ends but it may also be continued by the margo frontalis of the major wing which then rises up to the level of the margo sphenoidalis of the frontal bone. Very rarely does the crest extend to the angulus sphenoidalis of the parietal bone.

Therefore in anthropoids the floors of the fossae crania anterior and media give the impression of forming only 1 floor and are divided into 2 floors very close to the processus clinoideus anterior of the sphenoid. This is the usual condition in gorilla and orangutan[2] while in chimpanzee the ledge is more salient and extends farther laterally but never does it reach those dimensions nor strength characteristic of modern man much less early hominids. Thus the structures of the cerebral surface of the base of the skull are in perfect accordance with the conditions of the endocasts and the brains of the anthropoids as described above. The deficiency of the brain in the Sylvian area, the exposure of a part of the island of Reil and the development of a large Sylvian jugum cerebrale (Sylvian crest) are therefore distinctive features of early man that disappear in conformity with the progress of evolution. The fact that these features never occur in modern anthropoids leaves only 2 alternatives open for interpretation; they could be specific differentiations of early hominids who did not exist in still earlier phases, or they could be a very primitive character of a common human anthropoid stock, retained in man until the further expansion of skull and braincase and the transformation of the whole skull connected with this expansion led to their passing out of existence. Among anthropoids, the special differentiations of these apes tending toward extremely protruding jaws and the development of tusk-like canines, barred further differentiation of the brain or even brought about its reduction.

G. Schwalbe ('02, '07), believed to be the discoverer of the "Sylvian crest" on the cerebral surface of the parietal bone in modern man, found it completely absent in anthropoids and monkeys and therefore considered its appearance in man a progressive human character. Sir Arthur Keith ('38, '39) discovered the structure again in modern man, but since he found it absent in anthropoids, he regarded its occasional absence in modern man a sign of primitiveness. In the Piltdown fragments there is no trace of the crest according to Keith, therefore the author regards the Piltdown braincase as that of a primitive man although all other primitive features are missing. Now we know that primitive man has a Sylvian crest and Piltdown man, who has none, is therefore not a primitive but a modern human type. It would be very interesting to know to which category the Australopithecinae belong in this regard. The character of the endocasts of Australopithecus africanus and Plesiantropus transvaalensis suggest that the brain was that of a typical anthropoid (cf. Weidenreich, '47).

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[2] In my paper on the Sinanthropus skull ('43) I claimed that the Sylvian crest is "rather a constant occurrence in orangutan." The examination of more specimens makes a correction necessary. In adult orangutan a real crest is missing as in gorilla but in young individuals the ledge is usually well developed as it is in young chimpanzees, but never extends to the parietal bone.

It is, of course, a great temptation to draw far-reaching conclusions on the progress of mental and physical abilities of the types concerned from obvious deficiencies of the pallium, on one side, to a more perfect fullness, on the other. As the depression in the Sylvian region partly involves the center of Broca and the motor area, it is understandable that the filling up of the depression has been interpreted as an indication of a simultaneous acquiring of greater ability in locomotion and speech. I do not believe, however, that any achievements in these fields depend on a mere enlargement of individual convolutions or that such enlargements necessarily involve greater perfection in those performances.

II. THE DEFLECTION OF THE SKULL BASE

In earlier papers I stated that the distinct hump-like elevation of the vertex-obelion region of the brain and the corresponding "rolling-up" of the braincase characterize the appearance of a new form in human evolution, the neoanthropic man, generally known as "Homo sapiens." I considered this transformation a final step in the adaptation of the skull to new static and dynamic conditions necessitated by the acquisition of a perfectly erect posture. This adaptation brings the atlanto-occipital joint perpendicularly above the spine and at the same time more to the center of the skull base, securing in this way a better balanced equilibrium of the skull. The contrast to the anthropoids in this regard is evident.

In hominid stages preceding those of neoanthropic man, the conditions have been obscure because of the deficiency or complete lack of the basilar parts of the skull. Boule claimed that the skull of La-Chapelle-aux-Saints shows a more posterior position of the occipital foramen than found in neoanthropic man and deduced a more stooped carriage of the head from the length and strength of the dorsal processes of the cervical vertebrae. According to S. Sergi, however, the position of the occipital foramen in Neanderthalians scarcely differs from that of neoanthropic man. The same is true of the Rhodesian skull which certainly retained more primitive characters than any of the Paleoanthropines (Neanderthalians). On the other hand, all the Paleoanthropinae known so far differ from the Neoanthropinae by having a flat brain without any indication of the characteristically neoanthropic hump. Therefore the transformation of the paleoanthropine skull cannot have attained the perfection of the neoanthropine group.

The rolling up of the braincase in modern man is characterized by its bending around a transverse axis running approximately through the center of the mandibular fossae. This pushes the whole occipital part of the braincase, particularly the fossa cranii posterior, downward, and its frontal part forward and at the same time downward but to a lesser extent. The longitudinal axis of the base, originally stretched, undergoes thereby a deflection and the direct distance between their frontal and occipital terminals (nasion and basion) is shortened. For details the reader is referred to my monograph on the Sinanthropus skull ('43, pp. 136–139).

If this is correct, the deflection of the base must be most pronounced in neoanthropic man, less so in paleoanthropic man, and still less in archanthropic man. As far as modern man is concerned, the angle of this deflection, ''saddle angle'' or ''basilar angle,'' and especially its correlation with the degree of the prognathism, was the subject of studies by the authors 80 years ago, but after that time the entire problem lost interest. In most of the Neanderthal specimens, the basilar parts are missing, and in the rare cases in which they are in part preserved, only G. L. Sera mentioned the basilar angle in his study on the Gibraltar skull, using the diagram of a mid-sagittal section drawn by Sir Arthur Keith (fig. 5A). Sera noted that the occipital clivus declines less than in modern man and the angle is therefore greater. Boule, too, made the same observation on the skull of La Chapelle-aux-Saints. According to him, the occipital clivus exhibits a very gentle slope while the saddle angle comes closer to 180° than it does in modern man. Boule estimates the degree of that angle as between 135° and 150°, as against 132° in modern man, and 145° in anthropoids. However, Boule as well as Sera failed to recognize the real significance of the basilar deflection and its correlation with the elevation of the vertex. The same is true of Pycraft, who, in his description of the Rhodesian skull, depicts a diagram representing a mid-sagittal section through its braincase (fig. 5 B) which shows the clivus and the floor of the fossa cranii anterior. Concerning the base of the cranial cavity, Pycraft states that ''the clivus is steep, but not conspicuously so,'' and that the middle fossa as well as the posterior one are remarkable for their shallowness.

In none of the Sinanthropus skulls are the median basilar parts from the opisthion forward to the frontal sinuses preserved. Therefore, nothing can be said about the clivus and the degree of the basilar deflection from direct observation. However, when viewed from the inside of the cranial cavity, the position of the pyramid, preserved in part in skulls III, V, XI and XII, appears less flat and less prostrate than in the anthropoids and projects, therefore, considerably less into the cranial cavity; but compared with modern man, the pyramid is a good deal smaller and its superior crest is far less edged. This corresponds with the low position of the porion and the porus acusticus internus. As I have shown in my paper on the Sinanthropus skull ('43, pp. 137–138) the porion lies below the base line — nasion-opisthion — (average index

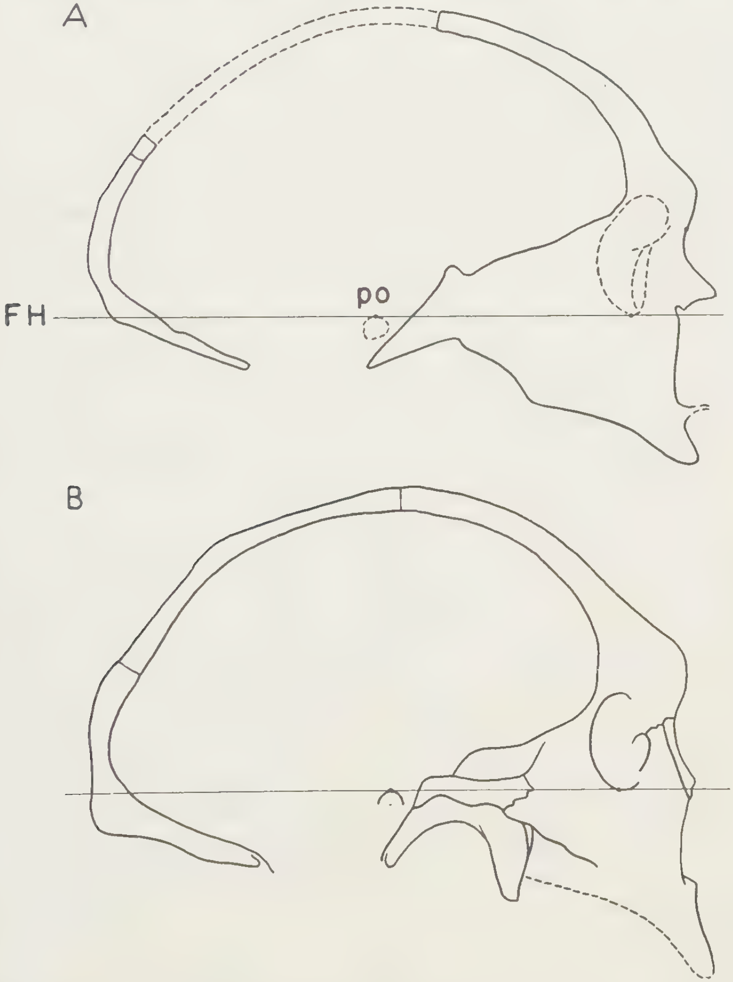

Fig. 5 Mid-sagittal craniograms of the Gibraltar skull and the Rhodesian skull showing the floor of the fossa cranii anterior and the occipital clivus. × $\frac{1}{3}$. A, Gibraltar skull after G. L. Sera; B, Rhodesian skull after W. P. Pycraft, a little less than $\frac{1}{3}$; FH, Frankfurt horizontal; po, porion.

— 3.3) in anthropoids, while it is above it (average index + 6.6) in modern man, and between the 2 marks (average index + 3.0) in Sinanthropus. Therefore, the klition (mid-sagittal landmark of the dorsum sellae) of Sinanthropus cannot have reached the same high level as it has in modern man, or in other words, the declivity of the occipital clivus must have been less steep than that of modern man, and the deflection of the base was less pronounced. In Pithecanthropus erectus the basilar parts in question are missing; in Pithecanthropus robustus the pyramids are preserved but they are crushed and dislocated and so do not permit a reliable estimation of the position of the klition and the declivity of the clivus which themselves are missing. Fortunately the critical region of the skull has been found almost intact in the 2 Homo soloensis skulls VI and XI. In both cases the matrix which still adhered could be completely removed both from the outer surface and the cranial cavity while the rubber method furnished whole endocranial casts. Although a part of the matrix had to be left on some spots, due to their inaccessibility from the occipital foramen and the broken roofs of the orbits (Skull XI), the only available means of entrance, casts of the cerebral surface of the base together with the outer surface could be made.[3] These were sufficient to reveal the characteristic form and structures of the base and those of the 3 fossae cranii as they appear in mid-sagittal sections through the skulls. Plate 3, figure 1 shows such a craniogram of skull XI, the missing median part of the anterior fossa cranii being restored after skull VI. For comparison with modern man, plate 3, figure 2 shows exactly the same conditions of an adult male Tasmanian skull (no. 275, American Museum of Natural History) which is remarkable because of the unusual thickness of its cranial bones.

The first feature of Homo soloensis skull which strikes the eye is the extraordinary lowness of its clivus and the short distance between basion and klition. The thickness of the sphenoid-occipital at the level of the klition is 8.5 mm compared with 23 mm in the Tasmanian skull. The basion-klition line in the former is 14 mm against 42 mm in the latter. No less surprising is the depth of the fossa hypophyseos; the thickness of the sphenoid-occipital at the floor of the fossa is only 2 mm against 18 mm in the Tasmanian skull. Although the base gains in thickness in the sphenoid region where its greater part is occupied by the sphenoidal sinus, it lags far behind our examples of modern man; 18.5 mm against 26.5 mm. This thinness of the Soloensis base contrasts conspicuously with its extent in length. The length measures around 60 mm from the basion to the sphenoidal rostrum in both skulls; while the greatest length of the braincase itself (glabella-inion) measures 198 mm in Homo soloensis VI against 190 mm in the Tasmanian; and the basal length (nasion-basion) 114 mm in the former against 106 mm in the latter. The reduction in length accords with the deflection of the base. In the Homo soloensis skull the basilar angle — difficult to determine exactly by any method — comes close to 160° while it is 130° in the Tasmanian skull. The thinness of the spheno-occipital bone contrasts also with the thickness of that of the occipital squama and the other cranial bones. Although skulls VI and XI belong to the least heavy ones of the Soloensis series, the thickness of the squama in the torus region reaches 22 mm against 18 mm in the unusually thick Tasmanian skull.

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[3] We owe this achievement to the great skill and fine comprehension of Mr. Otto Falkenbach.

That the condition of the base of Soloensis skull XI is not an exceptional individual variation follows from the fact that it is the same in skull VI and must, therefore, be regarded as typical of Homo soloensis, and, as suggested by Sinanthropus, also as typical of the whole archanthropine group.

The differences of the form and structures of the fossae cranii of the Homo soloensis skull compared with those of modern man are chiefly characterized, so far as the media and posterior fossae are concerned, by the differences in size and position of the pyramid, and in size and extension of the posterior fossa. I do not want to enter into details here; they will be discussed elsewhere. Attention is called only to the shallowness and width of the posterior fossa compared with the more constricted but deeper pit in modern man (cf. plate 3, figs. 1 and 2). This change in form is obviously the result of the greater deflection of the base of modern man which brings the occipital foramen farther down and thus transforms the fossa into a narrower but longer funnel. The greater massiveness of the Soloensis skull is also manifested by the strength of the 2 crura (left and right) which form the continuation of the crista occipitalis interna and embrace the occipital foramen. Modern man gives only a faint idea of this original massiveness even in cases in which it is exceptionally pronounced (plate 3, figure 2). The lifting of the dorsum sellae and the entire hypophysis area in modern man compared with its position in Homo soloensis (plate 3, figure 1) is obvious. Its amount can best be judged by the changed location of the apex of the pyramid; in Homo soloensis the apex is clearly above the dorsum sellae (processus clinoideus posterior) while in modern man the dorsum and its processus considerably overtops the apex. The deflection of the base which brings the fossa posterior down is also responsible for the differences between the level of the posterior fossa and that of the media. In Homo soloensis the latter lies only a little higher while the difference is much greater in modern man. On the other hand, the fossa anterior lies clearly higher than the fossa media in Homo soloensis while it is much lower in modern man. As I have already stressed above, the "rolling up" of the braincase around the transverse axis brings not only the posterior fossa, but also the anterior one downwards. This can best be demonstrated by superimposing the midsagittal craniograms of Homo soloensis and the Tasmanian (fig. 6). This shows that the flatness of the skull base in the Archanthropines and the corresponding flatness of the skull top is a genuine character of early man and the deflection of the base which is concurrent with the high elevation of the vertex is characteristic of neoanthropic man, even in its most primitive forms. The reduction of the length of the braincase, particularly its base, the descent of the occiput and fossa cranii posterior, and finally the more central localization of the occipital foramen in relation to the total basal length of the skull, are the effect of one and the same transformative process, the final "cause" of which is the adjustment of the skull to the acquisition of erect posture, as shown in my earlier papers.

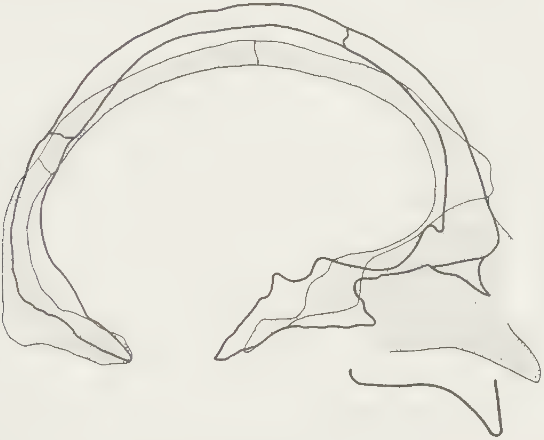

Fig. 6 Mid-sagittal craniograms of Homo soloensis skull XI (plate 3, fig. 1) and Tasmanian skull (plate 3, fig. 2) superimposed on the opisthion and the plane of the occipital foramen (each craniogram in its natural size) to show the deflection of the base around the hypophysis region, and the accompanying vertex elevation. The face (upper facial triangle) of the Homo soloensis skull after the reconstruction of the face of Sinanthropus pekinensis. Tasmanian skull — solid line; Homo soloensis skull — stippled area. × ½.

In figure 6 I also tried to show the effect the deflection of the base must have on the projection of the face, in other words, on the facial prognathism. In Homo soloensis no part of the facial skeleton has been preserved, therefore I took the closest archanthropine type available for such a purpose, the reconstructed Sinanthropus skull. The upper facial triangle determined by the nasion-basion, basion-prosthion and prosthion-nasion lines, and their respective angles as found in Sinanthropus has been attached to the nasion-basion line of the craniogram of Homo soloensis. When this triangle is compared with that of the Tasmanian skull, the differences are evident. The archanthropine face appears lower in height but protrudes much farther forward. This is in accordance with what is known about the correlation between cranial capacity and face (cf. Weidenreich, '41).

III. EARLY HOMINIDS AND ANTHROPOIDS

In the first paragraph I have shown that the depression of the Sylvian area in early hominids is a characteristic human feature and is not comparable to the conditions among living anthropoids. In the second paragraph I have shown that the deflection of the skull base and the elevation of the vertex are late developments in the phylogenetic evolution of man. As there is practically no deflection in early man, the question arises about the conditions in the great apes. Strangely, very little is known about the anatomy of the cerebral surface of their cranial cavity, the fossae cranii and the hypophysis region and other features referred to in the preceding pages. The reason for this lack of knowledge is, apparently, the reluctance of many museum people to open a skull and look at what is inside. I do not intend nor have I the time, to make up for what has been neglected. So I must confine myself to very brief remarks on this subject.

Taking first a male adult gorilla (plate 3, figure 3), we find the differences between the form of its brain-case and its cranial cavity, particularly the cranial fossae and the base are very conspicuous when they are compared with those of Homo soloensis on mid-sagittal craniograms (plate 3, figure 1). It is true that when the less spacious cavity of the gorilla is disregarded, its flatness is the same. Beside this, there are several important differences:

1. The thickness of the cranial wall in gorilla is markedly inferior to that of Homo soloensis if the sagittal crest, an entirely secondary structure of quite a different character, is neglected. This greater weakness of the wall is particularly striking in the region of the occipital squama. Here the wall is only about one-seventh the thickness of that of Homo soloensis. This is in great contrast to the conditions of the

front parts and the base. The thickness of the wall in the gorilla in the supraorbital region is more than double that of the soloensis wall, and, in the hypophyseos area it is a little less than double.

2. Another striking difference is the well-known fact that the occipital foramen faces backward rather than downward in gorilla. Here it occupies the very posterior end of the base while in Homo soloensis it has a location much farther forward, forming a part of the base itself. The inferior part of the occipital squama (planum nuchale), which is in a vertical position in gorilla, in Homo soloensis represents a part of the base, turning only slightly upward. The occipital condyles support the gorilla base almost at the posterior end of the lever, while in Homo soloensis this fulcrum lies forward from that end at a distance of about one-third of the total length of length of the lever.

3. The clivus ascends very gently forward and upward. Its total length from basion up to the dorsum sellae is 3 times the length of that of Homo soloensis. There is no indication of a fossa hypophyseos, the clivus ascending continuously to the tuberculum sellae. Only occasionally is there a rough transverse line where the dorsum sellae is expected to be found. A thin transparent bony plate which forms the roof of a greatly enlarged sphenoidal sinus, bridges the area where the hypophyseal pit should be.

4. The 3 floors of the fossae cranii arise in a very gradual ascent similar to the conditions found in Homo soloensis. But there are some characteristic differences; the gorilla pyramid is still flatter and more prostrate than in Homo soloensis and the posterior fossa is much smaller and less deep; the media fossa is wider than in Homo soloensis and its border against the anterior fossa is much less distinct than in the latter, the projecting edge of the lesser wing of the sphenoid being almost entirely missing. The floor of the anterior fossa rises abruptly toward the orbital roof from a deep median ethmoidal trough.

The craniograms are, in principle, the same in the 3 anthropoids as plate 4, figures 1 and 2 show. Beside the size, there are differences only in less important features. But in one structure, chimpanzee (fig. 1) and orangutan (fig. 2) differ from gorilla in a very characteristic way. Sometimes they have a dorsum sellae and usually a fossa hypophyseos which resembles at first glance that of modern man. The dorsum sellae is in those cases very high but consists of 2 separated tubercles set up on the clivus with a small base, yet they correspond to the processus clinoidei posterioris of man. In chimpanzee they join each other high up, so that an arch is formed bridging a rounded hole. In orangutan this arch may be missing, but then there is a wide span between the posterior processus and the elevated tuberculum sellae. The fossa hypophyseos is the area between this dorsum and the anterior elevation. It lies entirely above the clivus surface, in no case (cf. plate 4, figs. 1 and 2) is there a depression at the surface or the "corpus" of the sphenoidal bone. Orangutan differs, furthermore, in so far from gorilla and chimpanzee that the edge of the minor wing of the sphenoid projects more toward the media fossa thus marking a sharper margin between the media and the anterior fossae.

It is not without interest that the gibbon is intermediate between the anthropoids and Homo soloensis with regard to the location of the occipital foramen, the arrangement of the fossae cranii, the character of the clivus and the fossa hypophyseos (plate 4, fig. 3). However, there are other features leading away from the hominids; they will not be discussed in this connection. In any case, the conditions in gibbon show that the anthropoids represent a group clearly distinguishable by some characteristic features from the early hominids and more so from neoanthropic man. There are so far no direct links which span the gap between the hominids and the anthropoids. The Australopithecinae are regarded by some students as types which conform to the morphological requirements of such a demand, following the main line of anthropoids in all the features discussed in this paper. This judgment is based on the few facts known from Broom's and Scheper's publication ('45) and casts available at this museum. Broom, however, has just ('47) announced the discovery of an almost complete Plesianthropus skull in which the cranial cavity and the 3 fossae are exposed. Since they are still covered with matrix a definitive verdict must be withheld. But from Broom's and Robinson's pictures and description, it can be ascertained that, on one hand, the occipital wall of the cranial cavity is much thicker than is usual in anthropoids, bringing Plesianthropus closer to early hominids, while on the other hand, the lamina cribrosa region of the anterior cranial fossa is typically anthropoid in character.

With all reservations I want to stress one point. In the first paragraph of this paper I showed that the Sylvian crest and the corresponding depression on the Sylvian area of endocast and brain of early man indicate the retention of a juvenile character in contrast to the conditions in the anthropoids which reveal a more "advanced" stage of development in this regard. It is certainly not accidental that the form of the braincase and the basilar structure found in the adult anthropoids is more "advanced" than it is in their juvenile stage which is more "human-like." To take an adult male gorilla as an example: Sir Arthur Keith ('10) has shown that in the newborn gorilla the occipital foramen occupies a much more central position than in the adult. When the basilar length (hormion-basion) of the newborn is 100, its increase amounts to 120% in an adult male individual. Figure 7, a copy of Keith's illustration, gives a good idea of the enormous prolongation of the base. But it shows more: the nuchal portion of the occipital squama moves backward at the same rate as the base and its original curvature is more and more straightened out. Furthermore, there are other characteristic differences. Keith's illustration shows that the clivus of the newborn is much steeper, that there is a dorsum sellae and a distinct fossa hypophyseos. In figure 8 the craniogram of a juvenile male gorilla in which the first permanent molar has

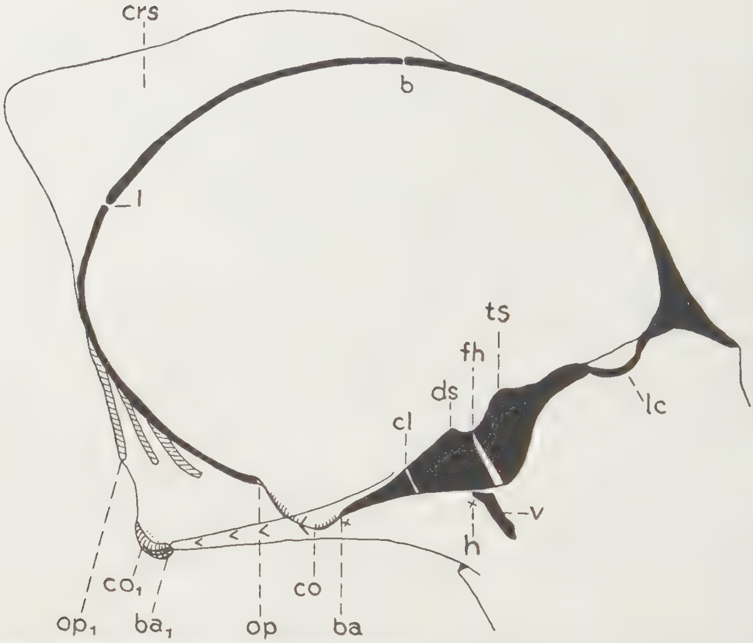

Fig. 7 Diagrammatic representation of the changes in the basilar part of the skull of the gorilla from the end of the eruption of the milk teeth until adult age. The black outline represents a tracing of the young skull, the shaded and stippled areas, the growth changes. After A. Keith, ('10, fig. 9).

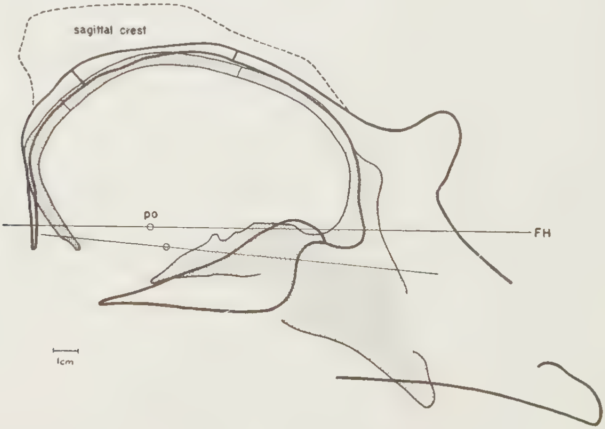

Fig. 8 Mid-sagittal craniograms of an adult male gorilla (C. A. 507, Amer. Mus. Nat. Hist.) and a juvenile male gorilla with milk teeth plus M 1 (L. 280, Amer. Mus. Nat. Hist.), superimposed at the center of the cranial cavity. Adult gorilla — heavy contours; juvenile gorilla — stippled area. FH, Frankfurt horizontal; po, porion. × $\frac{1}{3}$.

just erupted and that of an adult male gorilla are compared. As the increase of the cranial capacity during the intervening period of time is small and equal in all dimensions, the craniograms have been superposed at approximately the center of the cranial cavity. In this case, too, (fig. 8) the gorilla child shows a relatively short basilar section, a steep clivus, dorsum sellae and fossa hypophyseos well developed, and a tuberculum sellae high up. It shows, furthermore, a well curved occipital squama with the opisthion clearly bent inward; the occipital foramen thus keeps a position more in front and faces downward rather than backward. In addition, the 3 fossae cranii are arranged in 3 different levels, the anterior one at the highest, the posterior one at the lowest. All these peculiarities have disappeared in the adult gorilla, apparently as the result of the stretching of the base (fig. 8). The "juvenile" conditions of the gorilla just described are found, at least in part, in adult chimpanzees and orangutans (plate 4, figs. 2 and 3), but they are still more pronounced in juvenile stages.

It is easy to recognize the direct correlation between the prolongation of the base and the growth of the jaws and the development of the teeth, especially the permanent dentition, as figure 8 shows (cf. also Weidenreich, '41, '43). It seems that the extension of the base and the enlargement of the sinus which go hand in hand, also bring about the disappearance of the fossa hypophyseos and the smoothing out of all unevenness of the cerebral surface of the sphenoid.

The fact that the 3 anthropoids in the juvenile stage are closer to man than in the adult stage is in strange contrast to the conditions revealed by the comparison of Homo soloensis and modern man (fig. 6). So far as the deflection of the base in concerned, modern man shows more of the character of juvenile anthropoids, while early man more closely resembles that of the adult anthropoids. This is in accordance with the biological rules governing the relation between size of the brain and size of the skull (cf. Weidenreich, '41). However, the fact that anthropoids tend away from the "human" line the more adult they become, while man keeps to it, suggests that both groups originated from the same stem but that the anthropoids diverged toward specialization by virtue of an excessive development of their masticatory apparatus.

SUMMARY

The skulls of Homo soloensis offer the first chance to study the basilar parts of a skull of early man on the outside as well as the inside. Some of the results of this study are presented in this paper.

All the endocasts of Pithecanthropus and Sinanthropus show a distinct depression at the lower anterior region of the parietal lobe extending also to the upper region of the temporal lobe. The same depressed area occurs in the endocast of the Rhodesian skull, but it is missing in all the endocasts of Homo soloensis, although these skulls exhibit the same primitive characters as are found in Pithecanthropus and Sinanthropus. The location and character of the endocranial depression suggest that it is caused by a deficiency in the development of the pallium, particularly of the opercular portions of the parietal and temporal lobes. Foetal human brains, up to the time of birth, show this deficiency and, as a result, the Sylvian fissure appears widely "open" and the island of Reil exposed. The depressed area in the endocasts of early hominids may be due to the same deficiency. If so, adult early hominids have retained a foetal phase of human ontogenetic evolution. The filling up of the pallium in the phylogenetic phase represented by Homo soloensis is therefore tantamount to a process of maturing during the ontogenetic development of modern man.

The Sylvian depression of the endocast entirely coincides in location and extension with the formation of a crestlike bulge at the internal surface of the cranial wall. This bulge occupies the sphenoidal angle of the parietal bone and extends from there backwards and upwards toward the center of the bone. The "Sylvian crest," as this structure has been called by the authors is a rare feature in modern man but typical

of early man. It represents the continuation of the edge of the lesser wing of the sphenoidal bone toward the center of the parietal bone. The correlation between crest and depression is structurally and causally the same as that between any jugum cerebrale and any deeper fissure of the surface of the brain. The deficiency of the pallium is, therefore, the primary condition and the formation of the crest the secondary one.

No Sylvian depression is recognizable in any anthropoid endocasts. The Sylvian fissure is only indicated as a slight notch at the base of the endocasts between the temporal and frontal lobes. In well preserved brains the 3 adjacent lobes are tightly pressed against each other, and no jugum has developed. This feature conforms perfectly to what is revealed by the cerebral surface. In the adult gorilla, the anterior and middle cranial fossae form one almost undivided fossa in the critical region; there is no projecting edge of the lesser wing of the sphenoidal bone. In adult orangutan and chimpanzee a partition is recognizable but in no case do the structures come up to those of modern man, still less to those of early man. Young specimens have the wing edge more highly developed than do adult specimens. Nevertheless, the form of the simian endocasts differs characteristically from that of the hominids by the lack of a groove in the Sylvian area.

The most conspicuous feature revealed by Homo soloensis is the flatness and lowness of the sphenobasilar bone. The clivus is short and nearly even. The deflection of the base is minimal and the thickness of the bones is far below that of modern man, but the fossa hypophyseos is deep so that the bone of the floor of the fossa is no thicker than 2 mm. This weakness of the basilar part from the foramen magnum forward contrasts strikingly with the enormous thickness of other cranial bones, particularly with that of the occipital bone from the foramen backward. The flatness of the entire base also finds its expression in the arrangement of the 3 cranial fossae. The steps which lead from one cranial terrace to the other are very low and almost equal in height. In modern man with a well-developed deflection of the base, the posterior fossa is a wide funnel whose lower aperture (the foramen magnum) is situated far below the floor of the middle fossa while the height of the step between the middle terrace and the anterior or uppermost one is less. This flatness of the base is reflected in the degree of the dorsal curvature of the endocasts. The endocasts of Homo soloensis are only slightly curved as is characteristic of all hominid types preceding the phase of modern man. The vertex hump which appears first in the latter stage is closely correlated to the deflection of the skull base, the shortening of its length, and the rolling up of the entire braincase around a transverse axis which runs through the region of the mandibular joint. All these phenomena represent final adjustments of skull and brain to a perfect erect posture acquired by modern man.

The basilar parts and the walls of the cranial cavity of adult anthropoids differ remarkably from those of Homo soloensis. They agree with the latter only insofar as they both have scarcely a deflection of the base and that the terrace character of the 3 cranial fossae are the same in principle. But the total basilar length (nasion-basion) and that of the spheno-occipital (klition-basion) exceeds by far that of the hominids while the thickness of the cranial bones all around from the opisthion up to the supraorbitals is only a fraction of that of Homo soloensis and other types of early man. There is also a striking difference in the position of the occipital foramen. In all early hominids it is located fairly closely to the center of the base, whereas in the anthropoids it is at the posterior end. This location is the result of the enormous prolongation of the base during the postfoetal period of growth (cf. Keith). In other words, the conditions of juvenile anthropoids conform more closely to those of early hominids than do those of adult anthropoids. This holds good not only for the length of the base but also for other structures of the skull. Brain and braincase enlarge relatively little after the milk dentition is completed. The changes which determine the definite form of the skull, are, therefore, caused by the permanent dentition and the concomitant growth of the jaws. The close resemblance between juvenile anthropoids on one hand, and early and modern man, on the other, and the dissimilarities between them, increasing proportionally to the advance of age in anthropoids, suggest that the particular features of anthropoids is the result of specializations having set in during an early phase, bringing about the definite separation between hominids and anthropoids.

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PLATES

ABBREVIATIONS FOR PLATE 1

aci, arteria carotis interna
cbl, cerebellum
cf, carina frontalis
da, depressed area
fos, fissura orbitalis superior
hyp, hypophysis (fossa hypophyseos)
ic, incisura temporo cerebellaris (pyramidis)
lf, lobus frontalis
lo, lobus occipitalis
lp, lobus parietalis
lt, lobus temporalis
nh, nervus hypoglossus
nmd, nervus mandibularis (trigeminus III)
nmx, nervus maxillaris (trigeminus II)
nv, nervus vagus
of, operculum frontale
P, parietal bulge
pai, porus acusticus internus
S, Sylvian fissure
ssi, sinus transversus
ssp, sinus sphenoidalis (opened)
T, temporal bulge
vj, vena jugularis

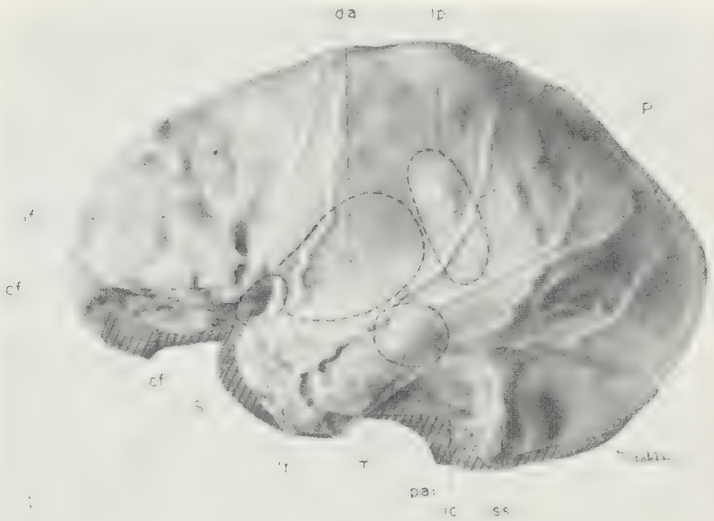
PLATE 1

EXPLANATION OF FIGURES

1 Endocranial cast of Sinanthropus pekinensis skull XII. Left lateral view. The depressed area (da) is encircled by broken lines. G. Elliot Smith's parietal (P) and temporal (T) ''expansions'' are indicated by dotted circles. The restored parts of the base are indicated by hatching. × $\frac{1}{2}$.

2 Endocranial cast of Pithecanthropus skull II. Left lateral view. The depressed area (da) is encircled by a broken line. The parietal (P) and temporal (T) ''expansions'' are indicated by dotted lines. The restored parts (restoration by F. Weidenreich) are hatched. × $\frac{1}{2}$.

3 Endocranial cast of Homo soloensis skull no. VI. Left lateral view. Area covered with matrix bordered by a broken line. × $\frac{1}{2}$.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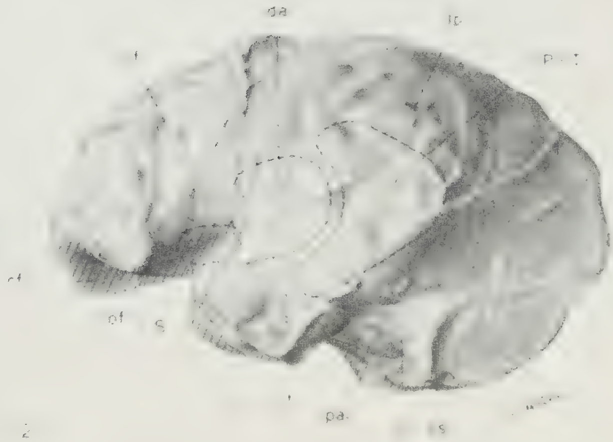
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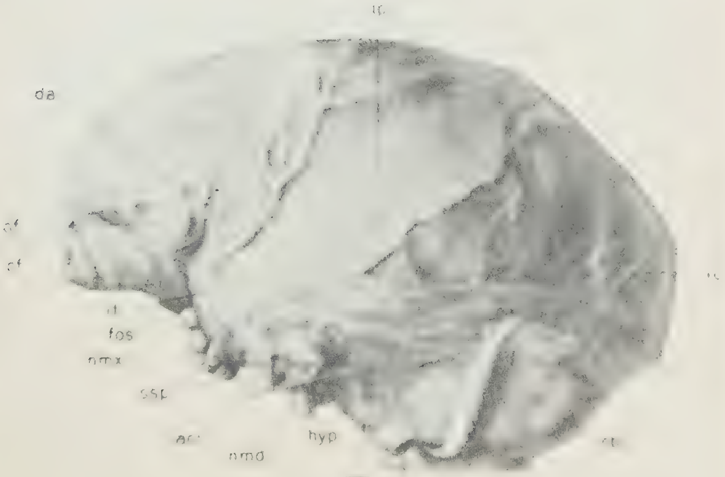
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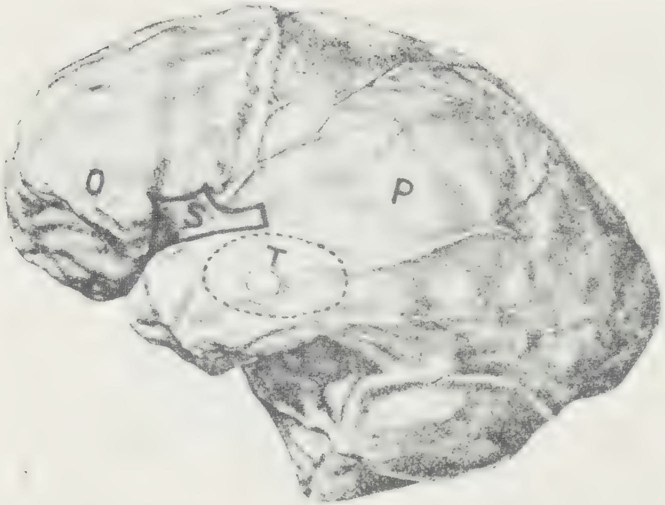
PLATE 2

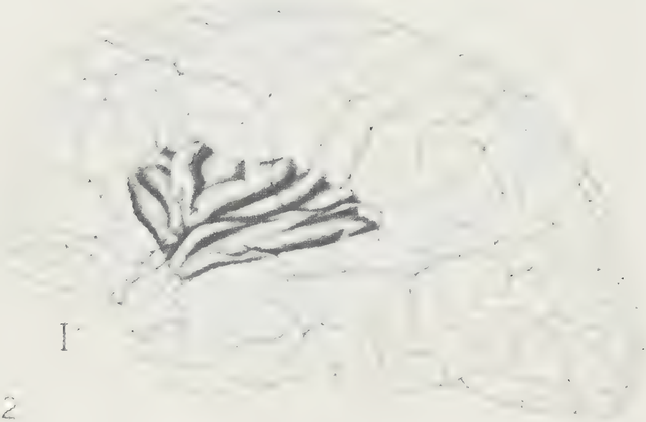
EXPLANATION OF FIGURES

1 Endocranial cast of the Rhodesian skull. Left lateral view. After G. Elliot Smith ('28, figures 12 and 13 combined). P, parietal prominence; O, frontal bulge; S, Sylvian "opening"; T, temporal prominence.

2 Left lateral surface of a modern human brain, in which the accurate location of the island of Reil (I) is indicated by shading. After Spitzka's edition of Gray's Anatomy ('13, fig. 683, p. 926).

3 Left lateral surface of the brain of human foetus at the age of 9 months. The island of Reil (I) is visible in the depth of the "open" Sylvian fissure. After G. Retzius ('06, pl. 30, fig. 4).





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ABBREVIATIONS FOR PLATES 3 AND 4

ap, ala parva ossis sphenoidalis
b, bregma
ba, basion
cg, crista galli
ch, canalis nervi hypoglossi
cl, clivus occipitalis
cn, crista unchalis (occipitalis)
co, condylus occipitalis
cps, crista petrosa superior
crs, crista sagittalis
cs, crus sinistra of crista occipitalis interna
ds, dorsum sellae turcicae
eci, eminentia cruciata
fca, fossa cranii anterior
fcm, fossa cranii media
fcp, fossa cranii posterior
fh, fossa hyphyseos
fj, foramen jugulare
fo, foramen occipitale
fop, foramen opticum
fsa, fossa subarcuata
gl, flabella
l, lambda
lc, lamina cribrosa
m, matrix
n, nasion
op, opisthion
pai, porus acusticus internus
pcp, processus clinoideus posterior
rs, rostrum sphenoidale
sc, sulcus caroticus
sf, sinus frontalis
ssi, sulcus sigmoideus
sso, synchondrosis spheno-occipitalis
ssp, sinus sphenoidalis
to, torus occipitalis
ts, tuberculum sellae turcicae

PLATE 3

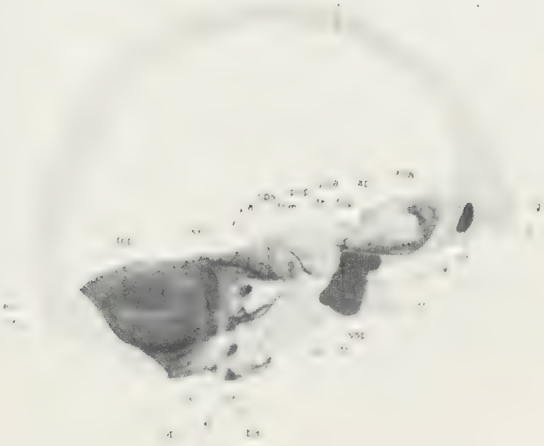
EXPLANATION OF FIGURES

1 Mid-sagittal craniogram with the basilar parts and the left 3 fossae cranii of Homo soloensis skull XI. × $\frac{1}{3}$.

2 Mid-sagittal craniogram with the basilar parts and the left 3 fossae cranii of modern man (Tasmanian skull) (no. 275, Amer. Mus. Nat. Hist.). × $\frac{1}{3}$.

3 Mid-sagittal craniogram of a male adult gorilla (C. A. 507, Amer. Mus. Nat. Hist.) showing the basilar parts and the 3 left fossae cranii. × $\frac{1}{3}$.

ba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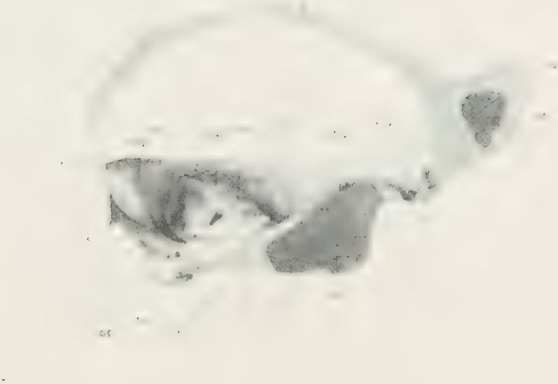


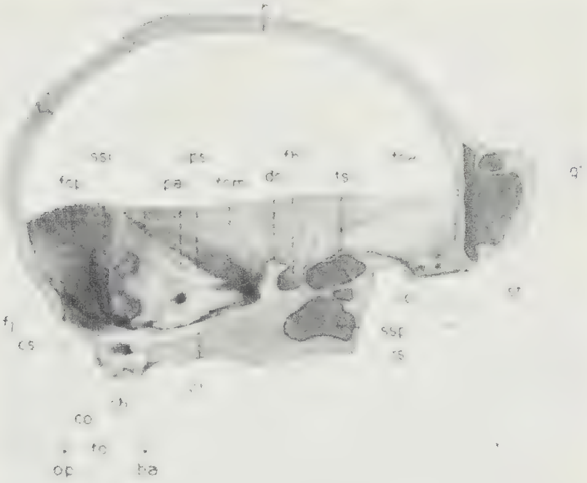
PLATE 4

EXPLANATION OF FIGURES

1 Mid-sagittal craniogram of an adult chimpanzee, in part copied from E. Selenka's figure 29, in part after specimens of the American Museum of Natural History collection. × ½.

2 Mid-sagittal craniogram of an adult female orangutan, in part copied from E. Selenka's figure 80, in part after specimens of the American Museum of Natural History collection. × ½.

3 Mid-sagittal craniogram of an adult male gibbon of the American Museum of Natural History collection –L (not further identifiable). × ½.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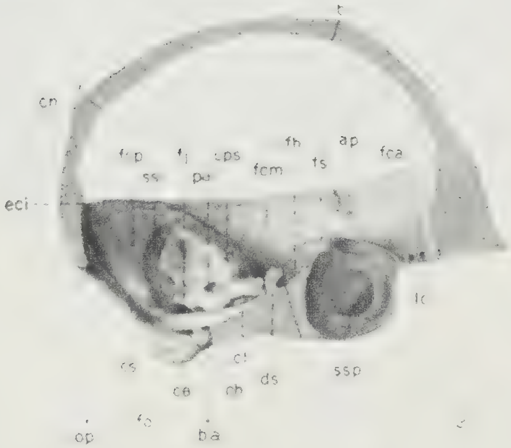
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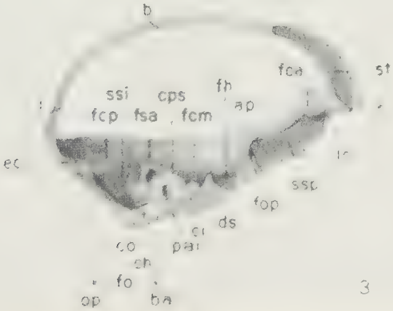
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Heredity: An International Journal of Genetics made its appearance in July under the editorship of Cyril D. Darlington and Donald A. Fisher. The first article is a series of abstracts of genetic research in Britain, 1939–1945. According to this, human genetics was investigated during this period only in the laboratories of Fisher, Race, Penrose and Haldane.

Future issues promise to include the following papers dealing with man:

Hereditary malformations in man. By Tage Kemp of Copenhagen.

The measurement of inbreeding in man. By H. J. Muller of Bloomington.

Heredity is printed and published in Great Britain by Oliver and Boyd, Ltd., Edinburgh (Tweeddale Court) and London (98 Great Russell St., W.C.). Annual subscription is $8.50; single numbers sell for $3.00.

Publications for Finland.— Finland has an excellent and keenly scientific minded Technical Institute, Teknillinen Korkeakoulu. During the war its library was bombed by the Russians and totally destroyed.

On my recent trip to Finland I discussed the situation with Dr. Marti Levon, Director of the Institute. He said he would welcome gifts of scientific and technical books and periodicals from America to take the place of those destroyed. In the remarkable efforts for recovery which the Finns are making, the lack of technical library facilities is a very serious handicap. It would be a practical act of friendship to a nation which holds America in high regard if Americans should contribute good technical books and periodicals to this library.

Any such gifts should be marked for the Institute of Technology, Helsinki, and sent to the Legation of Finland, 2144 Wyoming Ave., N.W., Washington, D. C. Dr. K. T. Jutila, the Finnish minister, will arrange for their being shipped to Finland.— Arthur E. Morgan, American Friends Service Committee, Yellow Springs, Ohio.

BLOOD GROUPING OF FOUR ABORIGINAL TRIBES IN KWEICHOW PROVINCE, CHINA

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Institute of Physical Anthropology, Academia Sinica

The Sino-Japanese war brought us to the interior part of China and thus provided an opportunity to get in touch with the aboriginal groups in Kweichow Province. Much work was done during the war years on the ethnological aspects of these peoples, but very little on the physical side. So far as is known, no report has ever appeared on their blood grouping. This work was done in the fall of 1942 with the purpose of finding some possible relations of these groups with the Chinese.

The 4 aboriginal tribes studied are the Pa-miao, the Chung-chia, the Lung-chia and the Keh-lao. They live in the southwest part of the mountainous Kweichow Province. The first 2 groups are more numerous and therefore more important. They have their own languages and customs, different from the native Chinese. The Lung-chia and the Keh-lao, however, are now nearly extinct and there are only a few hamlets inhabited by them in Anshun Hsien, P'uting Hsien and Pingpa Hsien which altogether do not contain more than 500 families. All of them can speak Chinese and most of the males dress like Chinese. The younger generations of the Lung-chia cannot even speak their own dialect; only those over the age of 60 can still speak it. Many of them have married into the Old Chinese or P'u-tsi or T'un-tsi families. It was rather difficult to find full-blooded members who would cooperate in this study, especially since they are very suspicious and reluctant to have a drop of their blood shed in peace, so the number of subjects typed is rather small.

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[1] Now in the Department of Anatomy, Washington University School of Medicine, St. Louis, Missouri.

This study was limited to the A and B factors. Before each person was tested, a brief enquiry of the ancestral history for 3 generations was taken. Those who have mixed blood (either with the local Chinese or peoples of other groups) were omitted. The high titre sera used in determining the blood groups were supplied by the Army Medical College then in Anshun Hsien of Kweichow. Phenol was added to the sera as a preservative. The tests were made by puncturing the tip of the finger with a needle and adding a drop of the blood to a drop of each of the sera on a slide. The blood and serum were mixed thoroughly with a thin glass rod. The slide was then tilted and rotated gently so that the cells were uniformly distributed. The agglutination of the corpuscles usually took place within 5 minutes and was easily visible to the naked eye; in case of doubt the slide was examined with the aid of a hand lens. Care was taken to adjust the amount of blood to the size of the drop of serum so as to get a uniform pale-red mixture; too much or too little blood would obscure the result. The glass rod was wiped after each usage and the sera were tested regularly against controls for their potency.

For comparative purposes, a series of blood groups of the Chinese in the southwest part of Szechwan Province was added to the study. This work was done recently in the district of the Old I-pin Prefecture of Szechwan Province. Altogether 1438 students in middle schools were taken. The high titer sera used were obtained from the Laboratory of Bacteriology, National Tung-chi University Medical College. One drop of blood from the finger-tip was mixed with 1 cm^3 of normal saline in a small test tube. Sterilized glass capillaries were used in transferring the blood suspensions to the slide and discarded after each using. The slide was examined under the microscope. Similar precautions were taken as described above.

The results of 2 Chinese series combined from previously published data (from Boyd, '39) and from the Southwest Szechwan series of the present writer are given in table 1 for the purpose of comparison. The term ''north'' is used to include those provinces along the Yellow River and the term "south" includes provinces to the south of those mentioned above. It can be clearly seen from this table that in the 2 combined Chinese series, the "north" has a higher frequency of q and the "south" has a higher frequency of p genes.

TABLE 1

Distribution of blood groups in the Chinese.

LOCATION	INVESTIGATOR	NUMBER	PER CENT IN EACH GROUP				GENE FREQUENCIES			D/σ
			O	A	B	AB	p	q	r	
Chi-li (now Hopeh)	Jettmar & Liu [1]	334	27.8	28.4	34.7	9.1	.222	.263	.527	1.0
Peking (now Peiping)	Huie [1]	1296	28.6	26.6	32.0	12.8	.208	.244	.535	2.33
Shantung	Jettmar & Liu [1]	114	22.9	31.6	36.9	8.7	.260	.295	.479	1.3
North China	All authors	1744	28.1	27.3	32.8	11.8	.215	.250	.530	
Canton	Dormanns [1]	992	45.9	22.8	25.2	6.1	.152	.166	.676	1.4
Chu-Kiang riverside	Fung-Min Yang [1]	339	43.4	30.4	17.5	8.7	.200	.122	.660	2.72
Hunan	Chi Pan Li [1]	1296	31.9	39.0	19.4	9.8	.277	.150	.565	1.4
Kiangsu	Yang & Lai [1]	600	33.7	30.0	25.0	11.3	.218	.186	.581	2.19
Southwest Szechwan	Ju-Kang Woo	1438	33.0	32.0	25.9	9.1	.231	.193	.575	0.2
South China	All authors	4665	36.3	31.6	23.2	8.9	.222	.169	.602	

[1] From Boyd ('39, pp. 169–171).

TABLE 2

Comparison of the distribution of blood groups of the 4 aboriginal tribes with that of the Chinese.

GROUP	CASES	PER CENT IN EACH GROUP				GENE FREQUENCIES			D/σ
		O	A	B	AB	p	q	r	
Pa-miao	164	25.0	22.6	37.1	15.3	.190	.288	.500	1.3
Chung-chia	200	44.0	23.0	21.5	11.5	.156	.146	.663	3.9
Lung-chia	104	41.4	26.0	23.1	9.6	.178	.160	.643	1.4
Keh-lao	54	33.3	29.6	24.1	13.0	.216	.181	.577	1.1
North Chinese [1] (combined)	1744	28.1	27.3	32.8	11.8	.215	.250	.530	
South Chinese [1] (combined)	4665	36.3	31.6	23.2	8.9	.222	.169	.602	

[1] From table 1.

Table 2 gives the percentage of each type in the 4 aboriginal groups tested in Kweichow Province and also the frequencies of the genes r, p and q calculated from formulae: $r = \sqrt{O}$, $p = \sqrt{O + A} - \sqrt{O}$, $q = \sqrt{O + B} - \sqrt{O}$ (Schiff and Boyd, '42, p. 224).

If we compare the data of the Pa-miao with those of the 2 Chinese series, it will be clearly seen that the frequency p of the first is the smallest and q is the largest. But both frequencies of Pa-miao are comparatively nearer to those of the North Chinese than to those of the South. In ancient Chinese history there have been legends of the migrations of the Miao from as far north as the Yellow River to the southwest provinces. This test seems to justify the historical sayings and also serves to indicate that the Pa-miao is one tribe of the Miao and comes from the North too. The Keh-lao have frequencies of both p and q between the 2 Chinese series. The probable explanation of this fact may be that this group is an aborigine of Kweichow as suggested by Clarke ('11), or migrated from nearby provinces in the central part of China. The most interesting feature is the very low value of both p and q of the Chung-chia. Many investigators have concluded from ethnological and linguistic studies that this group in Kweichow is closely related to the Shans or Tai race of Burma and Northern Siam. Unfortunately, little information, if any, about the blood types of that race has so far been available to enable us to make a comparison. But there is no doubt that the Chung-chia is very different from the other groups tested, and judging from the very low value of p and q, probably the tribe is affiliated with the Shans or Tai peoples. The Lung-chia have slightly lower frequencies of both p and q than those of the 2 Chinese series, and from the value of q they seem to be nearer to the South Chinese than to the North.

SUMMARY

Four aboriginal groups in Kweichow Province were tested for blood groups in this study. Blood groups of 2 Chinese series combined from previously published data and from

one series of Chinese of the southwest part of Szechwan by the present writer have been utilized for comparison. The Pa-miao have frequencies of both p and q nearer to the values of the North Chinese than to those of the South. Both frequencies of the Keh-lao lie between the North and South Chinese series. The Chung-chia and the Lung-chia have low values of both p and q, and are nearer to the South Chinese than to the North.

The writer is indebted to Dr. Mildred Trotter for aid in the preparation of this paper.

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* * *

Recent French Publications.— The following articles of interest to physical anthropology have been published recently in the *Bulletins et Mémoires de la Société d'Anthropologie de Paris:*

9ᵉ série, tome 4ᵉ, for 1943 (1945):

Gan, J.-K. Contribution à l'étude des dents chez l'Homme actuel et fossile. I. Sur quelques cas de rares anomalies et lésions dentaires chez les Hommes énéolithiques de l'Aveyron. pp. 39–46.

Gessain, R. De l'intérêt anthropologique des empreintes palmaires. pp. 66–75.

Herpin, A. De la molarisation. pp. 47–53.

KHERUMIAN, R. Contribution à l'anthropologie des Arméniens et le problème de la race dinarique. pp. 25–38.

PALES, L. AND CHIPPAUX, C. Contribution à l'étude de la stature chez les indigènes de Madagascar. pp. 54–65.

RIQUET, R. Les crânes néolithiques d'Avize, Marne. pp. 76–84.

VALLOIS, H. Les caractères différentiels des os longs chez certaines populations préhistoriques de la France. pp. 1–24.

9^e série, tome 5^e, for 1944 (1945) :

DELATTRE, A. Nouvelle méthode d'étude de l'anatomie comparée du squelette du crâne et de la face. pp. 47–52.

LALOUEL, J. Contribution à l'étude anthropologique des Annamites. pp. 42–46.

NEVEU, P. Sur une nouvelle méthode d'élaboration et d'interprétation des données anthropométriques: les déviations proportionnelles. pp. 1–7.

PALES, L. Le crâne trépané néolithique d'Aulnay-aux-Planches (Marne). pp. 24–41.

ROUVIÈRE, H. L'indice condylo-occipital; ses rapports avec l'orientation du trou occipital. pp. 19–23.

VALLOIS, H. Sur l'indice moyen de hauteur du crâne et la représentation graphique des indices de longueur-hauteur et largeur-hauteur. pp. 8–18.

———— La répartition anthropologique des groupes sanguins en France et plus spécialement dans le Sud-Ouest. pp. 53–80.

9^e série, tome 6^e, for 1945 (1947) :

CHIPPAUX, C. Triceps sural et mollet chez le Noir africain. pp. 228–238.

GAN, J.–K. Note sur un fémur humain rachitique d'un dolmen de l'Aveyron. pp. 63–70.

HARTWEG, R. Remarques sur la denture et statistiques sur la carie dentaire en France aux époques préhistorique et protohistorique. pp. 71–113.

OLIVIER, G. Contribution à l'étude anatomique du Noir africain. pp. 146–186.

PALES, L. Les constituants bio-chimiques du sang chez les Noirs africains transplantés en France. Étude comparative. pp. 15–62.

PALES, L. AND CHIPPAUX, C. Douze observations sur la morphologie des tendons de la patte d'oie chez les Noirs africains. pp. 114–121.

TISSERAND, M. Les variations de l'insertion du lobule de l'oreille chez les Français. pp. 122–130.

———— Morphologie du bord spinal de l'omoplate, étude statistique sur le vivant. pp. 131–145.

ULRICH, H. Crânes néolithiques alsaciens à caractéres négroïdes. pp. 217–227.

9^e série, tome 7^e, fasc. 1–3, for 1946 (1947) :

GRASSÉ, P.–P. La race en zoologie. pp. 12–15.

MANGENOT, G. La race en botanique. pp. 3–11.

PALES, L. AND TASSIN DE ST. PEREUSE La carte de répartition de la stature des populations de l'Afrique Occidentale Française. pp. 101–104 (and map).

VALLOIS, H.–V. L'omoplate humaine. Étude anatomique et anthropologique (Conclusion). Part 3, chapt. 11 and 12, pp. 16–100.

PHYSICAL DIFFERENCES BETWEEN RANKING AND NON-RANKING CONTESTANTS IN THE FIRST ANNUAL SCIENCE TALENT SEARCH

HAROLD A. EDGERTON, STEUART HENDERSON BRITT AND
RALPH D. NORMAN

*Richardson, Bellows, & Henry, New York City; McCann-Erickson, Inc.,
New York City; and Princeton University, Princeton, New Jersey*

TWO FIGURES

The subject of "racial" and physical differences between individuals who are significantly superior or inferior to others has long been of interest to scientists. In 1869, it will be remembered, Galton wrote his treatise on hereditary genius, in which he was concerned with the origins and physical measurements of outstanding men. Later studies tended in general to corroborate the early findings of superiority of those gifted in intelligence in physical characteristics, and to reveal as well facts pointing to the inferiority of the defectives in these same characteristics. Findings concerning "racial" differences have not been as clear-cut, largely because of serious questions concerning the appropriateness of the measuring instruments used to gauge intellectual behavior, and the difficulty of separating clearly defined racial groups.

I

The present study is concerned with physical and "racial" differences found between 2 groups of boys in late adolescence, one a group which achieved high status in a nation-wide search for scientific talent, and the other a superior group but one which did not win special mention in this competition. Members of both groups were contestants in the First Annual Science Talent Search, held in the spring of 1942, and described in greater detail elsewhere (Edgerton and Britt, '43a). Briefly delineated, this was the first in a series of competitions which have been conducted annually in the high schools of the United States by Science Clubs of America, and administered jointly by Science Service and the Westinghouse Electric Corporation. Twelve to 15,000 high school seniors have been participating each year for the past 6 years.

In the first search, to which the data of the present investigation apply, 3,175 students out of approximately 14,000 for whom entrance materials were requested, actually submitted completed entries for the contest, which included a series of hurdles described below. Of these students, 40 boys and girls were eventually winners, and 260 were given honorable mention. The proportion of girls to boys selected was the same as the proportion among the participants who submitted complete entrance materials. The 40 winners were then brought to Washington, D. C., to compete for the two $2,400 Westinghouse Grand Science Scholarships; and others of these trip winners were awarded $100 to $400 Science Scholarships granted by the Westinghouse Electric Corporation.

The selection of outstanding contestants was made by means of the "successive hurdles" method. These hurdles were set up as follows:

1. *Science aptitude examination.* This was to select those who had the aptitude to study science in colleges, but the examination did not place too heavy a premium on previous knowledge of science (Edgerton and Britt '47).
2. *High-school record.* A transcript of the high-school record was required, and also a statement of the contestant's rank in the senior class, which was used as a basis for a composite score.
3. *Score on the recommendations furnished by high-school teachers.* Trained raters scored the factual information requested in terms of specific actual accomplishments (Edgerton and Britt, '43b).
4. *Essay rating.* Each contesant was required to write an essay of fixed length on the subject, "How science can help

win the war." This essay was read separately by 3 judges with somewhat different scientific backgrounds.

Two further hurdles were applied only to the 40 trip winners, in order to furnish additional information to aid in the selection of the top scholarship winners. These hurdles were:

5. *Personal interview.* A standardized psychological interview conducted by each of 3 independent interviewers was used to rate certain traits.

6. *Social attitudes test.*

All contestants were exposed to the first hurdle, the science aptitude examination. Those who survived this hurdle went on to the second, or evaluation of their high-school record; those who survived the second went on to the third; survivors of the third went on to the fourth, etc. Thus, 3 classes of contestants emerged, which in this study will be referred to as Winners, Honorable Mentions, and Others (the "also rans").

No information was had, at the time the 40 selections were made, of either the "race" or religious affiliations of the contestants. In other words, every effort was exerted to conduct the competition in the most impartial manner, attention being paid only to the qualifications of the contestants in terms of their ability to meet the criteria set up at each of the "successive hurdles." The aim was to choose the most promising creative scientists, without any consideration of skin color, religious affiliation, or data external to the qualifications sought. Thus, attention was not given to the physical condition, or to physical characteristics such as height, weight, or any other morphological factor.

A definite plan was developed for an annual followup by means of a questionnaire sent out by Science Service to all those who submitted full credentials. An exception was made so that, if an individual did not reply for the first 2 years in succession, he was dropped from the followup inquiry.

Only male contestants were made the subject of this study, largely because the girls were comparatively few in number. For purposes of statistical comparison, the first 2 groups, that is, the winners and honorable mentions, have been combined into a single group (hereafter referred to as group A), since it is obvious that these groups have more in common in terms of high standing in the contest. However, comparisons will be made between the winners and the others as well, to emphasize the differences found. The Others group is referred to as group B in this study. Data which are given here are for the first 3 years of followup. The data were taken from replies to a standard followup questionnaire sent out to all contestants.

It should be noted here that the B group itself was a superior aggregate of individuals. In the second followup year, for example, 76% of the B group reported they were in college at the time they had completed their questionnaire. In the third followup year, 54% of this group reported college attendance (the fall in percentage was due largely to the war). Although these figures were significantly less than the A group's percentages for those years, they were still far above the average. In addition, although there is an element of bias in the returns of the questionnaire, as will be noted later, the B group earned just about an academic grade of B, on the average. Also, at least 22% of this group reported having received one or more scholarships or fellowships during the first followup year (Norman, '46). The B group is superior, in other words; and actually the fact that they entered this difficult competition may be considered prima facie evidence of this fact. Hence, differences found in this study are actually between a very gifted group of boys and another which is only somewhat less superior.

In the various tables that follow, comparisons are made between the A group and the B group. Since the questionnaire was completed by the contestants themselves, there might be some "halo effect." However, if this is the case, we would expect as much "halo" in one group as in another, and thus differences would still exist.

Also to be considered is the element of error of self-estimation, disregarding halo. It was obviously impossible to have exact physical measurements on all the more than 2,000 boys who entered the competition. So, an individual actually 5 feet, 6 inches tall might report himself as 5 feet, 7 inches tall. If such errors did occur, however, it is expected that overestimations, in a large enough group such as ours, would be about equal to underestimations, according to the law of average error, so that errors would serve to cancel themselves out.

To be kept in mind, too, is the fact that some bias is indicated in the percentages of returns each year, the bias being directly proportional to status in the contest (Edgerton, Britt and Norman, '47). For example, among male contestants in the first followup year, winners made a 97% return of the questionnaire, honorable mentions made a 93% return, and others an 80% return. In the second followup year, winners again made a 97% return, while honorable mentions made 86%, and others only 63%. In the third followup year, winners made perfect returns (100%), honorable mentions dropped to 79%, and others were down to 57%.

Moreover, a separate analysis of the returns of the others group indicates definitely that individuals who made better scores on the science aptitude examination tended to return the questionnaire more faithfully than those who were lower on the examination. The mean test score, for example, of those who made no returns at all was 69.5, while for those who returned the questionnaire for 3 years in succession, it was 75.6. With these facts in mind, it is apparent that 2 inferences are probably true: (1) Data for the first followup year are probably the most representative of, or at least most closely approach, whatever differences exist among *all* members of both groups. (2) The B group members returning the questionnaire will probably bear closer resemblance to the A group as the years go by. Even for the first year, it may be noted that questionnaires were not received for 20%, perhaps the poorest one-fifth of the B group. Thus, each year, whatever superiority is found for the A group is probably greater because of the somewhat selected sample being obtained from the B group.

The mean ages for the 2 groups *at the time of the first followup* were: A group, 19.02 years; B group, 19.23 years. For winners alone, the mean age was 18.48 years, a figure just about three-fourths of a year younger than the mean for the others group. The numbers of cases were: First year — A group, 220, B group, 1,786; second year — A group, 204, B group, 1,394; third year — A group, 191, B group, 1,257.

II

Table 1 gives the data on the matter of "race" for the 2 groups. Only one Negro is represented in the winner and honorable mention groups combined. Statistical significance at least at the 1% level exists in favor of the Whites, and in disfavor of the "others" racial group.

TABLE 1

"Racial" differences of both groups (first year only).

"RACE"	GROUP A		GROUP B		DIFFERENCE	CRITICAL RATIO
	no.	%	*no.*	%	%	
White	219	99.55	1,749	97.93	1.62	2.70[1]
Negro	1	0.45	21	1.18	0.73	1.46
Other (Chinese and "yellow")	0	. . .	8	0.45	0.45	3.21[1]
No data	0	. . .	8	0.45	0.45	3.21[1]
Totals	220	100.00	1,786	100.01	. .	. . .

[1] Significant at the 1% level.

Our results may be compared with those of Terman ('26), who found that Negroes represented 2% of the total of the combined population of the cities studied in his survey of "gifted" children, but that they furnish only 0.3% of the gifted group. He indicates that there was "a great deficiency of Negro ancestry." Freeman, ('34), after a very thorough reivew of the psychological data which have been gathered on the American Negroes, concludes that the present intellectual status of the American Negro is on the whole appreciably inferior to that of the white population. But Stoddard's words of caution are quite appropriate. He says:

> It is not an easy thing to demonstrate genuine inferiorities or superiorities asociated with racial or national groups. The place of any group on the general socio-economic scale will vary with the country, the region, and the times.
>
> The same difficulties met with in testing Negroes are found in the testing of American Indians, or of tribes and nationalities that depart strongly from present-day white civilization ('43, pp. 243, 248).

On our own study, we may note that, by and large, since white pupils have greater odds of achieving senior class status in high school, they will be "over-represented" in the whole mass of contestants in a search such as this. Also, non-white competitors may not always have had as accurate academic marks or as good ratings as the white boys.

III

Turning to the question of height, we find that the A group is slightly taller than the B group but not significantly so. This is shown in the first 2 columns of table 2, and graphically in figure 1. Table 2 presents data for the first followup year of this study only. This trend of superiority persists throughout the 3 years of the investigation — for year I, the mean of the A group is 70.31 and for the B group, it is 70.01. For year II, the values are 70.33, and 70.26; and for year III, 70.59, and 70.43, respectively. The height for the winners group alone is 70.67, which mean value is greater than the mean of the B group, but the critical ratio of the difference is only 1.17. Thus, despite the difference in mean ages (if we assume slight changes in growth at age 19), the A group tends to remain slightly taller, and the top winners even more so than the B group.

Table 1 and figure 1 also illustrate that both groups are significantly taller than a sample of 6,730 Army men who were inducted in May, 1943. This group includes only men accepted for military service, both white and colored, but excludes those rejected for such service (Army Service Forces, '44). If we had included rejectees, who are inferior physically to accepted men, our differences would have been even more marked. The "under 20" age group was chosen because it most closely approximates the mean age of the subjects of this study.

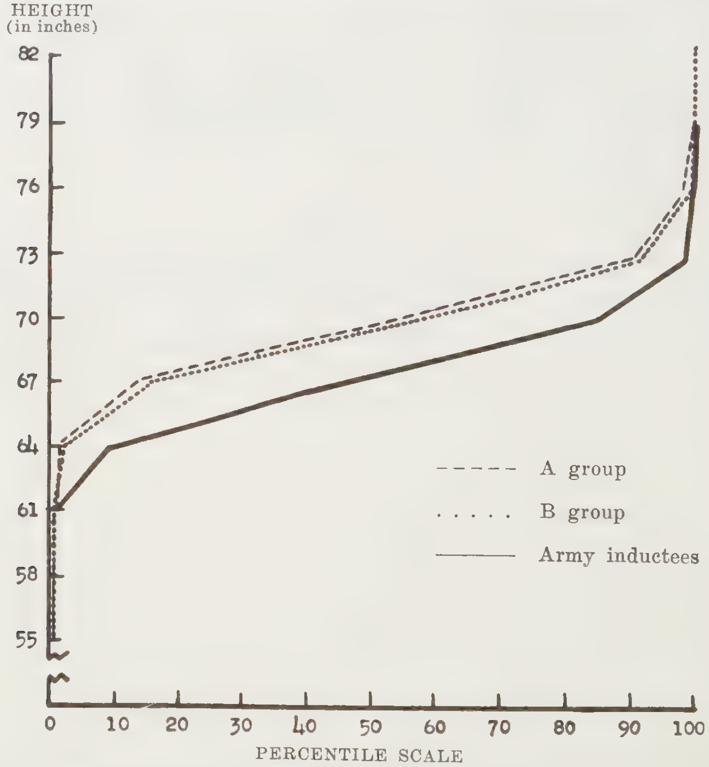

Fig. 1 Cumulative frequency curves illustrating the differences in height among the A group, the B group, and a comparable army inductee group.

Both the A group and the B group are well above the mean height of the Army inductees, which is given in table 2 as 68.14.

The A group is 2.17 inches taller than this figure, on the average. The C. R. of this comparison is 12.76 which means the difference found is far beyond any statistical doubt. The C. R. between the B group and inductees is 27.91, even higher yet, the mean difference being 1.87 inches. This lends evidence to the statement mentioned above, namely that the B group itself is probably a superior aggregate.

TABLE 2

Height of both groups (first followup year only) compared with height of 1943 Army inductees.

HEIGHT	GROUP A	GROUP B	INDUCTEES
(inches)	%	%	%
80–82	...	.1	...
77–79	.9	...	.1
74–76	8.2	7.8	1.3
71–73	36.8	33.8	13.1
68–70	40.9	43.2	41.0
65–67	11.4	12.4	35.5
62–64	...	1.7	8.4
59–61	1.4	.2	.6
56–58	...	...	...
53–55	...	.1	...
No data	.4	.7	...
Total	100.0	100.0	100.0
N	220	1,786	6,730
Mean	70.31	70.01	68.14
S. D.	2.56	2.47	2.52
σM	0.17	0.06	0.03

Differences and critical ratios.

	DIFFERENCES	C. R.
Group A vs. group B	.30	1.63
Group A vs. inductees	2.17	12.76
Group B vs. inductees	1.87	27.91

Although our study is not strictly comparable to other researches on the gifted, largely because our groups have already attained relative maturity, and also because there is strong evidence that we are comparing a superior group with another not quite so superior, it is interesting that our results are in agreement with those of other investigators. Hollingworth ('26), for example, reported that her gifted group of 45 children with chronological ages between 7 and 9, and with a median IQ of 151, had a median height 1.8 inches greater than the controls matched for age, race, and sex. They were also 3.3 inches taller, on the average, than a group testing at IQ 65 and below. Following the gifted group up in a later investigation (Hollingworth, '30), she found that these children were consistently 5% taller as a group in early maturity. Terman ('26) reported that his gifted as a group were above the best standards for American-born children in physical growth. Yoder (1894), studying the childhood of 50 great men, found a tendency to greater height among them than among average persons. Witty ('40) has reported the same fact in his study of gifted children in the Midwest. Ellis ('04) stated that there was a bi-modal distribution of the tall and the short among his British men of genius, but with the tall predominating; and Galton (1890), writing in the last century, when we might assume heights at maturity to be somewhat less than they are today, found the height of his men of science, nevertheless, to be 69.5 inches on the average. Paterson ('30), critically evaluating all the important studies of height and weight in relation to intellect reports a very slight positive correlation (0.15) between height and weight and intelligence.

IV

Table 3 presents data on weight in both groups for the first year only, compared with the weight of the Army inductees. Figure 2 illustrates the comparison. Comparing the first 2 columns of table 3, it will be noted that the B group tends to be slightly heavier than the A group, the means being respectively 153.85 pounds, and 153.05 pounds. This slight superiority continues for the next 2 years; the weights are 158.64 pounds, and 156.88 pounds for year II, and 161.49 pounds, and 160.00 pounds for year III respectively. The statistically insignificant difference in favor of the members of the B group may be accounted for by the fact that they are, on the average slightly older (roughly .2 of a year, as noted in part I). Our top winners, for example, are even lighter than the A group mean as a whole, with a mean of 150 pounds, but their younger age should be considered in the total picture.

TABLE 3

Weight of both groups (first followup year only) compared with weight of 1943 Army inductees.

WEIGHT	GROUP A	GROUP B	INDUCTEES
(pounds)	%	%	%
275–294	...	.1	...
255–274	.4	.1	...
235–254	...	.1	.2
215–234	...	.1	.5
195–214	.9	2.2	1.5
175–194	9.1	9.2	4.5
155–174	29.1	31.2	19.1
135–154	46.4	44.5	41.3
115–134	13.7	11.5	29.0
95–114	...	.7	3.9
No data	.4	.4	...
Total	100.0	100.1	100.0
N	220	1,786	6,730
Mean	153.05	153.85	144.76
S. D.	17.90	18.35	19.58
σM	1.21	0.44	0.24

Differences and critical ratios.

	DIFFERENCES	C. R.
Group A vs. group B	.80	0.62
Group A vs. inductees	8.29	6.74
Group B vs. inductees	9.09	7.39

Both our groups are definitely superior to the comparable Army inductee group, which has a mean of 144.76 pounds. The A group is 8.29 pounds heavier, and the C. R. of this comparison is 6.74, significant statistically to a degree much higher than the 1% level. The B group is 9.09 pounds heavier, and the C. R. of this comparison is 7.39, also highly significant statistically. Again, this is evidence of the superiority of our B group over the average. Thus, with regard to comparison of our groups with an average American of the same age, our findings are entirely consistent with those of Terman, Hollingworth, Witty, and others, on the superiority in weight of the intellectually gifted.

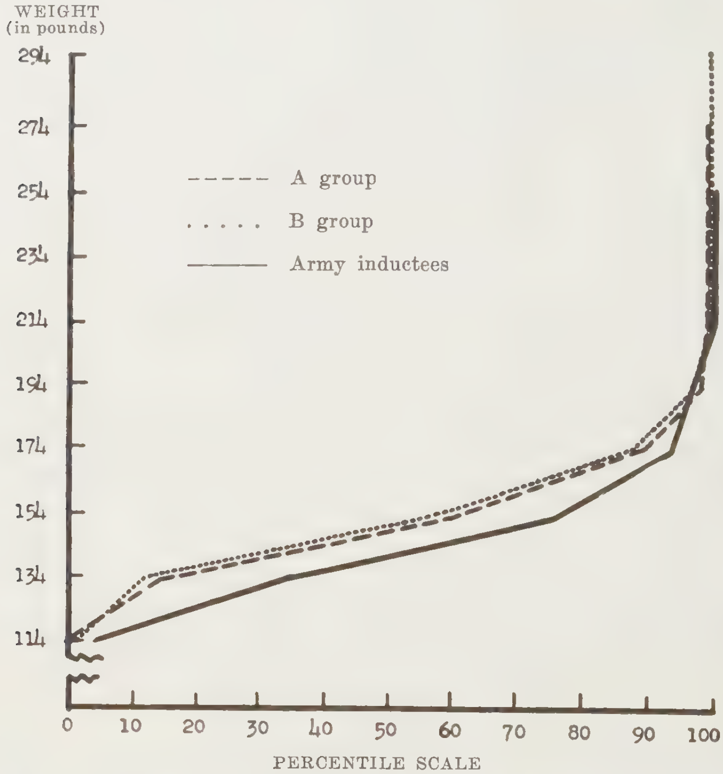

Fig. 2 Cumulative frequency curves illustrating the differences in weight among the A group, the B group, and a comparable army inductee group.

V

The data presented in table 4 appear to indicate some superiority for the A group in physical condition, except for the significant excess (11%) of poor vision in this group for the first year. The figures concerning "None" and "No data" probably have to be interpreted with caution. The questionnaire used stated: "Specify any physical defect, disease, or

TABLE 4

Physical condition of both groups for first 3 years of followup.

Physical defect reported	YEAR I						YEAR II						YEAR III					
	Group A		Group B		Difference	Critical ratio	Group A		Group B		Difference	Critical ratio	Group A		Group B		Difference	Critical ratio
	no.	%	no.	%	%		no.	%	no.	%	%		no.	%	no.	%	%	
None	124	56.36	1,184	66.29	9.93	2.76 [1]	181	88.73	1,152	82.64	6.09	2.44 [2]	156	81.68	923	73.43	8.25	2.66 [1]
Visual	53	24.09	229	12.82	11.27	3.76 [1]	5	2.45	17	1.22	1.23	1.23	2	1.05	6	0.48	0.57	0.71
Hearing	5	2.27	8	0.45	1.82	1.82	0	. .	5	0.36	0.36	2.57 [2]	0	. .	2	0.16	0.16	1.60
Respiratory	1	0.45	17	0.96	0.51	1.02	0	. .	13	0.93	0.93	3.10 [1]	2	1.05	10	0.80	0.25	0.31
Limbs	5	2.27	13	0.73	1.50	1.50	2	0.98	11	0.79	0.19	0.24	4	2.09	22	1.75	0.34	0.28
Digestive	1	0.45	3	0.17	0.28	0.56	0	. .	1	0.07	0.07	1.00	0	. .	2	0.16	0.16	1.60
Circulatory	1	0.45	10	0.56	0.11	0.22	2	0.98	11	0.79	0.19	0.24	0	. .	6	0.48	0.48	2.40 [2]
Nervous system	0	. .	3	0.17	0.17	1.70	0	. .	4	0.29	0.29	2.07	1	0.52	7	0.56	0.04	0.07
Teeth	0	. .	3	0.17	0.17	1.70	0	. .	0	. .	. .	. .	0	. .	0	. .	. .	. .
Other	9	4.09	38	2.13	1.96	1.31	0	. .	20	1.43	1.43	4.77 [1]	1	0.52	22	1.75	1.23	1.76
No data	21	9.55	278	15.57	6.02	2.62 [1]	14	6.86	168	12.05	5.19	2.60 [1]	26	13.61	265	21.08	7.47	2.58 [1]

Note: Totals in this table may not add up to 100% because one individual might report more than one defect.

[1] Significant at the 1% level.

[2] Significant at the 5% level.

disability. If none, write 'None'.'' It is entirely possible that many individuals meant ''No data'' for ''None,'' i.e., they did not write, ''None,'' but left the space blank. But it is a curious phenomenon that the B group each year has had a much greater percentage (statistically significant) who give ''No data'' responses than the A group. This may yet be another expression of interest on the part of the A group!

The most striking superiority in physical condition for the A group appears in the second and third years. Significantly fewer (6%) B group members report no defects; and significantly greater numbers report deficiencies in excess in hearing, respiration, and ''other'' areas in the second year. In the third year, again B group members report no defects in significantly lesser percentage (8%), and circulatory defects in percentage larger enough to reveal a difference significant at least at the 5% level.

A separate analysis of data concerning the winners group, or very top contestants, as contrasted to the others group, reveals that the trend of superiority on the part of the higher ranking group is emphasized; thus, for the first year there are significant differences, at least at the 1% level, in favor of the others group for defects of the respiratory organs and limbs. However, the others group is again superior in vision in this year, since 20% more of winners report a visual defect, a figure significant at the 5% level. For the second year, significant differences again exist in favor of the others group for respiratory and limb defects, and ''other'' defects; and for the third year there are differences existing at least at the 1% level in favor of the others group with reference to repsiratory, nervous system, and ''other'' defects.

In general, these facts correspond quite closely to those found by Terman in his study of gifted children in California. In that investigation, the schools reported about a quarter more cases of defective vision for that group than for the control group in the elementary-school individuals studied. Twenty-three per cent of his gifted boys and 33% of his gifted girls had somewhat defective vision in the high-school group.

This compares strikingly with the 24% of visual defect reported by the A group in the present study, and with the 33% for the winners group separately. But as regards other areas of health and physique, the intellectually gifted group is slightly superior, Terman says, to the generality of children. Leta Hollingworth, too, claimed that the gifted in her studies were generally superior in health when compared with age norms.

An effort was made to compare our data on physical defect with the latest Selective Service data. Strict comparison, such as was made with height and weight, was not possible, principally because the classification of defect used in this study differs radically from the Selective Service classification, which was much more elaborate. It was found of interest, however, to contrast the category of "no defect" in the Selective Service data with the same category in our table 4. This comparison may be somewhat tenuous, in that the inductee data are derived from physical examinations (conducted by physicians) which would be more likely to include reportable defect than our questionnaire, which asked the respondent to report about himself. But it cannot be gainsaid that superior groups such as ours, would quite likely be aware of defect because of the greater probability of better medical care and their superior intelligence.

If, then, we may compare the "no defect" categories, it is of interest to note that Selective Service reports 45.3% of registrants between the ages of 18 to 24 years with no defect, between the months of April, 1942, and December, 1943. This includes both white and colored in the continental United States; white registrants fare slightly better than the whole group, having 45.8% with no defect. These figures are derived from a study of a sample of approximately one-fifth of over 9,000,000 men to whom pre-induction physical examinations were given (National Headquarters, '44). Table 4 shows that 56.4% of the A group and 66.3% of the B group report no defect, and if we include the "No data" category, we find that 65.9% of the A group and 81.8% of the B group make no positive indication of some type of physical defect. Thus, keeping in mind the possible reservation noted in the paragraph above, it would seem that both our groups are well superior to a comparable age group drawn from a large representative sample of American youth, in freedom from physical deficiency of some sort.

VI

SUMMARY

Physical and "racial" differences between 2 groups of male contestants in the First Annual Science Talent Search were examined and contrasted with a comparable Army group. Ranking (A group) contestants consisted of winners and honorable mentions; non-ranking (B group) contestants achieved no status. The latter group, as a whole, is also a superior group.

Materials in this study were derived from a 3-year followup with mailed questionnaires, which have some bias. The A group, using data for the first followup year only, has a significant excess of Whites, and a deficiency of "other" (excluding Negro) races. This group is superior in height, although the difference between the means is not statistically significant. It is slightly inferior to the B group in weight, but age differences may account for this. Both groups are significantly superior in height and weight to a comparable Army group.

Except for the first followup year, in which the A group has a significant excess of poor vision, it is significantly superior in physical condition. Trends found in the A group are emphasized in the winners group considered separately. There is strong suspicion that both groups are superior to comparable Selective Service registrants in freedom from physical defect. This study, therefore, is in agreement with previous researches on the gifted in intelligence.

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FRANZ BOAS . . . approached the study of man from every angle . . . What is more, from the start he saw the need of acquiring in each branch of the science the highest degree of technical equipment. The physical anthropologist must use the tools of biometrics; the linguist must become a phonetician and an analyst along the lines of Indo-European philology; the ethnographer must envisage the subtler as well as the more obvious phases of social life — folk-literature, music, the subjective attitudes of primitive man no less than artifacts or social structure. Nothing is more remarkable than the systematic way in which Boas, trained in quite different fields, acquired the techniques requisite for the highest type of work in the several subdivisions of anthropology . . .

As a physical anthropologist he deprecated sheer taxonomy; defined race on a profounder basis; demonstrated the (*nota bene,* limited) plasticity of the human organism; studied the phenomena of growth on a major scale; and was one of the earliest investigators to note segregation in hybrid human groups.— Robert H. Lowie. Biographical memoir of Franz Boas, 1858–1942. Nat. Acad. Sci. Biogr. Mem., vol. 24, no. 9, 1947, pp. 303–322. (This short memoir contains only a selected bibliography of 24 titles owing to the fact that the American Anthropological Association has issued an obituary memoir (Memoir 61, 1943), which contains a complete bibliography and articles on Boas as a man (A. L. Kroeber), an ethnologist (Ruth Benedict), a linguist (M. B. Emeneau), a physical anthropologist (Melville J. Herskovits), a folklorist (Gladys A. Reichard), and an archaeologist (J. Alden Mason) — Ed.).

NEW ABSTRACTING SERVICE.— Section I of *Excerpta Medica,* covering the fields of anatomy, anthropology, embryology and histology made its appearance in October. For the purposes of this setion anthropology means only physical anthropology. Subdivisions include statistics, palaeo-anthropology and genetics. The editors have set for themselves the objective of preparing for publication abstracts of *every* article in the respective fields appearing in the medical literature of the world.

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The indigenous population of the Marianas continued to diminish until, by the middle of the nineteenth century, no full-blooded natives survived. However, the Chamorros mated with the newcomers, and soon after the conquest a hybrid group began to emerge. This was composed mainly of the offspring of Chamorro women and Spanish or Filipino men, for it became an established Spanish policy to send Filipino convicts and political prisoners as conscript laborers to Guam.— Laura Thompson. Guam and its people. Princeton University Press, 1947, xiii + 367 pp. ($5.00).

FINGER PRINTS OF AFRICAN PYGMIES AND NEGROES

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FOUR FIGURES

The investigation here recorded was based upon a collection of finger prints of African pygmies and Negroes made by the well-known researcher of Africa, Dr. P. F. J. A. Julien. Julien, who chiefly carried out a blood-group investigation among the peoples he visited (the results of which have partly been published), collected in 1932–1939 also various groups of finger prints which he has placed at my disposal. I am greatly indebted to Dr. Julien for the opportunity offered me of studying this unique and extensive material.

Dactyloscopic analysis, like other aspects of physical anthropology, requires that the number of test persons be sufficiently large; no less than 200 individuals in each group were examined. In view of the known sexual differences in the frequencies of the pattern types it would have been desirable to examine equal numbers of men and women. This unfortunately has not been attained in the groups examined; in general it is difficult to get sufficient data of female individuals. Nevertheless, the results from males and females are stated separately.

In former publications I have referred to the finger prints of African pygmies and Negroes collected by Julien: 207 Efé pygmies of the Ituri region, Belgian Congo (Dankmeijer, '34, '38); 343 Negroes of Liberia and Sierra Leone (Dankmeijer, '38). The statistics relating to these peoples are included here for purposes of comparison.

The groups whose finger prints are recorded for the first time are:

(a) 233 Bakóla pygmies (130 males and 103 females), living in the southwestern part of the French Cameroons.

(b) 303 Báyaka pygmies (203 males and 100 females), living in French Equatorial Africa, between the Sanga and Oubangui rivers.

(c) 234 Negroes (115 males and 119 females) from the basin of the River Sanga (so-called Sanga Negroes) of French Equatorial Africa.

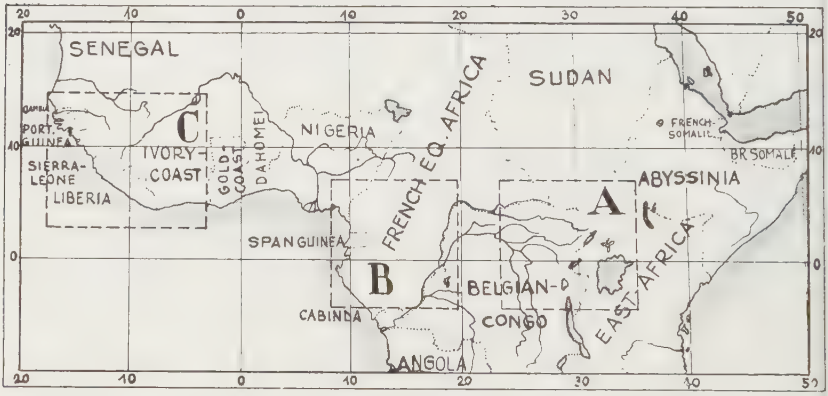

Fig. 1 General view of Equatorial Africa. Outlined sections lettered A to C are shown enlarged in figures 2 to 4.

(d) 317 Negroes (200 males and 117 females) of the Bassari and Coniagui tribes from the frontier region between French Guinea and Sénégal.

The places of abode of the groups are indicated on the maps; figures 2–4 represent the detail of the regions circumscribed in figure 1. It must be noted that the places indicated show only the abode of those groups of whom finger prints were taken. The entire regions occupied by the respective populations are considerably greater. Furthermore, finger prints have not been collected from all the known pygmy groups. There is wanting, for instance, a dactyloscopic examination of the interesting Bakah pygmies who live in the

Middle Cameroons, to the west of the Sanga River. This group was examined by Julien in his travels, but unfortunately he had no opportunity to record finger prints.

In his investigation of the tribes, Julien made other anthropological researches, in particular on blood groups, and has published data respecting the Efé pygmies and the Liberia and Sierra Leone Negroes (Julien, '35, '37). Concerning the other populations to be discussed in this publication, however, he has not yet made known his results.

If we first consider what is known up to the present respecting the distribution of the papillary patterns in Africa, it appears that but few investigations have been carried out upon adequate material. Whereas the results of dactyloscopic researches in many lands, in particular in Europe, America and Asia, have been published of late years, in Africa with a population so extremely interesting from an anthropological point of view, very little dactyloscopic study has been made as yet. In 1938 I gave a survey of the dactyloscopic investigations in the whole world known to me which had been made upon numbers of persons greater than 200. This study contains only 2 groups of individuals of Africa, namely, the Efé pygmies of the Belgian Congo and the Negroes of Liberia and Sierra Leone, described by myself in the same article. These 2 series, collected by Julien, together with 2 investigations (which came later under my notice) made upon 250 Negroes of Libya by Falco ('17–'18) and on 275 Negroes of Portuguese Africa by de Pina ('36), are the only ones of Africa made upon more than 200 persons. (The investigation by M. Weninger ('37), mentioned below, on 205 Batwa pygmoids has bearing unfortunately only on the prints of the right thumb and right index finger.)

The results regarding the different finger-patterns among the Efé pygmies and Negroes of Liberia and Sierra Leone are given here again in table 1 (exclusively of the 10 fingers together; as to the distribution of the papillary patterns upon the separate fingers see Dankmeijer, '34, p. 51, and '38, tables 4 and 5).

TABLE 1

Percentage of papillary patterns in Efé Pygmies and West African Negroes from Liberia and Sierra Leone (after Dankmeijer, '38).

	MALES					FEMALES					MALES AND FEMALES				
	Arches	Ulnar loops	Radial loops	Whorls	$\frac{\text{Arch}}{\text{Whorl}}$ — index	Arches	Ulnar loops	Radial loops	Whorl	$\frac{\text{Arch}}{\text{Whorl}}$ — index	Arches	Ulnar loops	Radial loops	Whorls	$\frac{\text{Arch}}{\text{Whorl}}$ — index
Efé Pygmies (54 ♀, 153 ♂)	15.9	61.6	2.8	19.6	81.1	17.0	60.7	2.0	19.6	86.7	16.2	61.3	2.7	19.6	82.7
West African Negroes (105 ♀, 238 ♂)	5.5	62.2	3.3	28.8	19.1	8.5	61.4	2.2	27.9	30.5	6.4	61.9	2.9	28.5	22.5

TABLE 2

Percentage of papillary patterns in different populations of Africa (after data found in literature).

POPULATION	NUMBER OF INDIVIDUALS INVESTIGATED	ARCHES	ULNAR LOOPS	RADIAL LOOPS	WHORLS	$\frac{\text{ARCH}}{\text{WHORL}}$ — INDEX	AUTHOR
Efé Pygmies	143	16.4	65.7	1.5	16.3	100.6	Valšík, '38
Negroes of Central Africa	25	7.2	54.4	1.2	37.2	19.4	Valšík, '38
Basúa (bastards)	24	8.8	62.9	1.0	27.3	32.2	Valšík, '38
Pygmies (bastards)	24	12.4	67.5	2.6	17.5	70.9	Valšík, '38
Bushmen	32	16.4	64.8	3.7	15.1	108.6	Weninger, '36
Hottentots	50	5.1	72.2	4.1	18.6	27.4	Fleischhacker, '34
Negroes of Libya	250	5.0	61.8	2.0	31.2	16.0	Falco, '17–'18
Negroes of Liberia and Sierra Leone	58	3.6	56.3	1.0	38.9	9.3	Cummins, '30
Tebù's (Cufra, Sahara)	140	8.9	61.5	4.2	25.3	37.2	Sabatini, '35
Negroes of Portuguese Africa	275	5.1	68.3		26.5	19.2	De Pina, '36
Negroes, Negrilloes and Pygmies of Belgian Congo	87	7.3	52.9		39.8	18.3	Mutrux-Bornoz, '37
Nhembas (Ganguelas) of							

The Efé pygmies examined form a subgroup of the Bambuti pygmies whose abode is in the basin of the Kibali-Ituri (Belgian Congo, fig. 2). According to Julien ('35), the region is practically bounded on the north and east by the road Betongwe-Gombari-Arebi-Kilo, and south and west by the roads Wamba-Avakubi-Irumu. The figures in table 1 show clearly the peculiar distribution of the papillary patterns in these pygmies, characterized by a very low percentage of whorls and a very high percentage of arches. Both numbers, compared with what is known of other peoples, are quite exceptional, as is seen in the values of the arch-whorl index

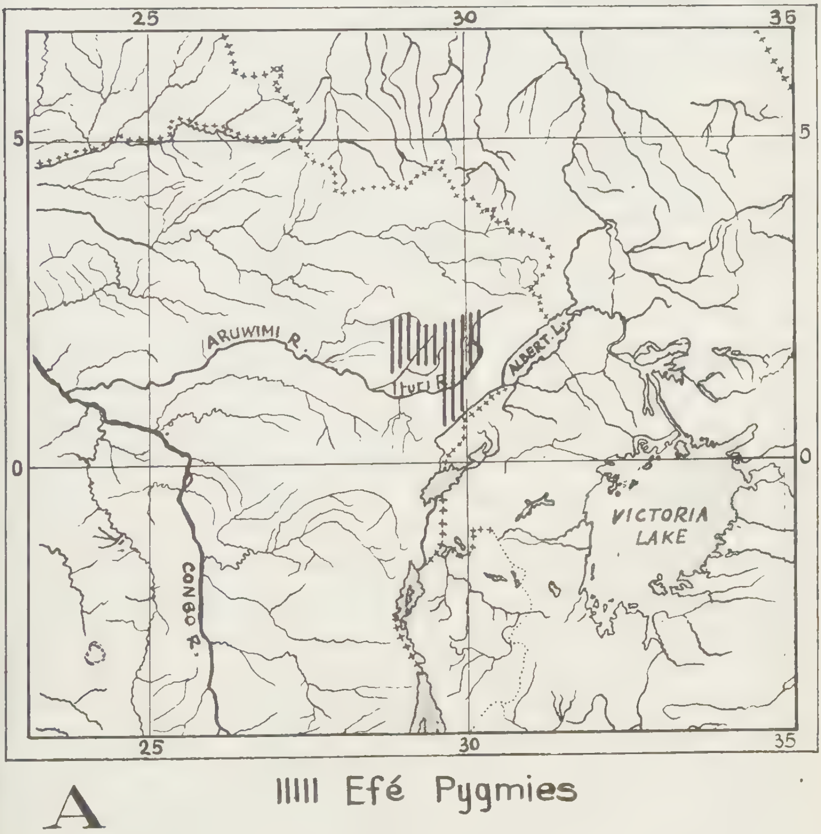

Fig. 2 Section A of figure 1 enlarged to show habitat of Efé pygmies.

$\left(\frac{100 \times \text{percentage arches}}{\text{percentage whorls}}\right)$ (Dankmeijer, '34)[1] which for males is 81.1 and for females 86.7. Such high indices had never hitherto been observed anywhere (see Dankmeijer, '38). As regards their dactyloscopic peculiarities, the Efé pygmies stand entirely apart from other peoples. Some years after I had made use of Julien's material the results of this investigation were completely confirmed by Valšík ('38), making use of material collected by Schebesta ('38) from Efé pygmies. This material comprises 1302 finger prints taken on 143 pygmies; Valšík's figures are to be found in table 2. Valšík, comparing his results with my own data, came to the conclusion that there was no actual difference between the figures of the 2 studies. Valšík likewise found a very high percentage of arches and a very low percentage of whorls. The arch/whorl index, computed for males and females together is 100.6. From these 2 investigations, carried out quite independently, the conclusion may safely be drawn that the Efé pygmies have a very high dactyloscopic index, depending upon the frequent occurrence of arches, coupled with a very low percentage of whorls. Remarkable are the results of Valšík's investigations among pygmy hybrids (see table 2), although these were obtained from small numbers of persons. Owing to the pygmy influence these cross-breeds of Negroes and pygmies show a higher index than the Negroes. The index is lower, however, than of the pure-bred pygmies. As regards the Basúa who, according to Schebesta, are crossings with a predominating negroid strain, the index is also higher than that of the Negroes, though lower than that of the pygmy hybrids. These figures furnish clear evidence of the hereditary nature of the papillary patterns, and thus render the dactyloscopic investigation of immense service as an anthropological method.

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[1] In the literature other indices are used. A whorl/loop index has been suggested by Furuhata ('27), whereas Poll ('37) besides using my index has employed the third possibility, the arch/loop index. I give preference to the arch/whorl index because there is a greater diversity in the incidence of arches and whorls throughout the world than in that of the loops. Moreover the arch and whorl possess a negative correlation in the sense that a rise in the percentage of arches is accompanied by a lower perecentage of whorls, and vice versa.

Margarethe Weninger ('37) studied the finger prints of the right thumb and right index-finger, which P. Schebesta had made of Batwa pygmoids living in the region around, and northeast of Lake Kivu and on the Island of Ijwi. In this material of over 200 persons (many prints, however, were too indistinct to be of use), with an almost equal number of males and females, she found a distribution of the patterns from which the following indices are computed:

a. R. Thumb:	Index 34.6
b. R. Forefinger:	Index 45.7

For the 207 Efé pygmies (54 females and 153 males) which I examined, these indices can be calculated from the figures given in my publication of 1934 (table 4, p. 51):

a. R. Thumb:	Index 40.8
b. R. Forefinger:	Index 81.5

It thus appears that the Batwa pygmoids have a fairly high arch/whorl index, but considerably lower than the values found among the Efé pygmies.

Another collection of finger prints respecting a group likewise belonging to the pygmoids, has also been worked out by M. Weninger ('36), viz., the collection of finger prints of 32 Bushmen, made by R. Pöch in 1907–09. This material was collected from a people living in the western portion of the Middle Kalahari, near the frontiers of British Bechuanaland. From an anthropological point of view the material is not strictly positive, however, for Weninger, according to Pöch's own data, states there were also Hottentots among these people. Moreover, the number of persons was too small to yield reliable results. The distribution of the patterns, according to Weninger's examination, is given in table 2, for all the fingers together. It would appear that these Bushmen also have a high percentage of arches and a low percentage of whorls, which is borne out in the high index of 108.6.

On the subject of Hottentots a publication has appeared by Fleischhacker ('34) who examined the palm and finger prints collected by H. Lichtenecker. The material concerns 50 persons, 42 males and 8 females (see table 2), living in Keetmanshoop and Berseba. The finger prints differ noticeably from those of the Bushmen and of the pygmies aforesaid. The index for the Hottentots is much lower, viz. 27.4, which is caused especially by the lower arch percentage. Whorls apparently are rare among the Hottentots: hereby the value of the dactyloscopic index is still so high that the Hottentots, as far as concerns their finger prints, resemble the Europide group. Fleischhacker had already remarked upon this. As will appear below, the index of the Hottentots is also found among those of different Negro tribes.

In 1937 Mutrux-Bornoz published the results of an examination of the finger prints of 87 inhabitants of the Belgian Congo. His material consists for the greater part of prints of negrillos or pygmoids from different regions of the Congo. The figures are given in table 2; the arch/whorl index computed from his figures is 18.3.

As regards the African Negroes, the literature contains some data. Falco ('17–'18) made an investigation of the finger prints of 250 Negroes of Libya and compared the results with those of the same number of Berberians and Italians. Falco's classification differs in some points from mine but as he gives a good description of his pattern-types it was possible to calculate the percentages of the figures after my own classification. The arch/whorl index of his material (see table 2) may be estimated as 16.0. Cummins, in 1930, published the results of an examination of 100 Negroes (soldiers) from Liberia and Sierra Leone. Of only 58 individuals were the finger prints of all 10 fingers serviceable. From the percentages for the various figures (see table 2) an arch/whorl index of 9.3 can be computed. This low index differs very remarkably from the high values of the southern pygmies; though in close agreement with my figure for Liberian Negroes, the index is lower than in most of the groups of Negroes reported by other authors and by myself.

De Pina ('36)[2] instituted an investigation among the Negroes of Portuguese Africa, but his publication is not at my disposal. From Valšík's comments ('38), however, I gather that de Pina determined in 275 persons (241 male and 34 female) the figures which are given in table 2. The index to be computed for this group is 19.2.

Also the results of Sarmento ('39) for 113 Nhembas and 107 Quiôcos of Portuguese Africa, are given in table 2. The indices for these groups of Negroes (all males) are respectively 12.0 and 26.1.

The above mentioned finger prints from Liberia and Sierra Leone Negroes which I studied myself, are given again in table 1. The material consists of the finger prints of 150 Negroes (89 males, 16 females) of Liberia of the tribes Kroo, Bassa, Gbande, Kpelle, Manoh, Geh, Gio and Buzi, and of 238 Negroes (149 males, 89 females) from Sierra Leone of the tribe of Mende (see fig. 4). Respecting this material, I have already published more than one communication. In 1934 I recorded the results of a small part (65 persons) that was at my disposal at that time. In 1938 I published the figures of the entire collection[3] obtained from 343 persons. The figures for all fingers together are given again in table 1. The index obtained from them is 22.5. The material from Liberia and Sierra Leone I took together, as the number of Negroes from Liberia is too small to yield reliable results.

On a further consideration of the material it appeared to me, after all, not undesirable to record the results of the 2 groups of Negroes of Liberia and Sierra Leone also separately; not because the 2 groups of people differ so widely from each other in anthropological respects, but just for the contrary reason. For Julien ('37), who had made a blood-group test of both groups, came to the conclusion from the figures he obtained that the 2 groups are in close affinity and most probably have been separated from each other only in recent times. Moreover, although the material from Liberia is too small for a comparison, the figures may still be of use in further investigations of the finger prints of Negroes.

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[2] De Pina's report of 1936, here cited, merely included for comparison the results of an earlier study, the 1934 paper included in the list of references. Therefore it is the 1934 paper to which reference should be made. — Ed.

[3] In this publication, page 377, ''Liberian Negroes of Sierra Leone'' should read: ''Liberian Negroes and Negroes of Sierra Leone.''

The outcome of my investigation is given in table 3. This table gives the figures for the Negroes of Sierra Leone, males and females separately, as also for the males of the Liberia Negroes. The number of women among the Liberian Negroes (16) is too small to justify statistics of the separate fingers. Though the results have but little significance, I give here the numbers for these 16 persons, which relate to all the fingers taken together:

	Per cent
Arches	9.4
Ulnar loops	70.0
Radial loops	0.6
Whorls	20.0

The Negroes of Sierra Leone, all fingers taken together, have an index of 22.8 for the men and 25.0 for the women. Thus, here is a sex difference of the same nature as was found elsewhere, viz. a higher index for females. For males and females (238 individuals) the figures for the Negroes of Sierra Leone are:

	Per cent
Arches	6.9
Ulnar loops	61.6
Radial loops	2.5
Whorls	29.0

Arch/whorl index: 23.8

For a comparison with the figures observed among Negroes I may mention an investigation carried out by Davenport and Steggerda ('29) on Negroes in Jamaica. They examined the finger prints of 124 Negroes and found among them 10.8% arches, 2.3% radial loops, 56.9% ulnar loops and 29.0% whorls. The arch/whorl index is thus 37.2, a value higher than I found in African Negroes.

TABLE 3

West African Negroes.

	SIERRA LEONE										LIBERIA				
	Males (n = 149)					Females (n = 89)					Males (n = 89)				
	Arches	Ulnar loops	Radial loops	Whorls	Index	Arches	Ulnar loops	Radial loops	Whorls	Index	Arches	Ulnar loops	Radial loops	Whorls	Index
Right hand															
Digit I	7.4	41.6	0.0	51.0	14.5	9.0	33.7	1.1	56.2	16.0	5.6	42.7	0.0	51.7	10.8
II	10.1	45.6	10.1	34.2	29.5	11.2	49.4	6.7	32.6	34.4	5.6	44.9	16.9	32.6	17.2
III	10.7	68.5	2.7	18.1	59.1	9.0	76.4	0.0	14.6	61.6	3.4	78.7	1.1	16.9	20.1
IV	0.7	58.4	0.7	40.3	1.7	2.2	58.4	0.0	39.3	5.6	1.1	61.8	0.0	37.1	3.0
V	2.0	87.2	0.0	10.7	18.7	1.1	85.4	0.0	13.5	8.1	0.0	83.8	0.0	16.2	0.0
Total	6.2	60.3	2.7	30.9	20.1	6.5	60.7	1.6	31.2	20.8	3.3	61.3	3.8	31.6	10.4
Left hand															
Digit I	7.4	39.6	1.3	51.7	14.3	12.4	37.1	4.5	46.1	26.9	9.1	48.9	0.0	42.0	21.7
II	12.2	47.3	12.2	28.4	43.0	13.5	44.9	9.0	32.6	41.4	4.5	56.8	13.6	25.0	10.0
III	10.1	72.5	0.0	17.4	58.0	9.0	75.3	0.0	15.7	57.3	3.4	80.9	0.0	15.7	21.7
IV	3.4	65.8	0.7	30.2	11.3	2.2	67.4	0.0	30.3	7.3	0.0	68.5	1.1	30.3	0.0
V	2.0	90.6	0.0	7.4	27.0	3.4	85.4	0.0	11.2	30.4	0.0	79.5	0.0	20.5	0.0
Total	7.0	63.2	2.8	27.0	25.9	8.1	62.0	2.7	27.2	29.8	3.4	67.0	2.9	26.7	12.7
Both hands	6.6	61.7	2.8	28.9	22.8	7.3	61.3	2.1	29.2	25.0	3.3	64.2	3.3	29.1	11.3

A small quantity of material collected from Negroes (26 individuals) of Central Africa has also been studied by Valšík ('38) (see table 2). From his figures an index of 19.4 may be computed.

Now follows a description of the results obtained from the examination of the finger prints of the groups last examined.

I may remark here that classification of the finger print patterns has been made in the same manner as indicated in my Thesis ('34). Accordingly, of the transition patterns between the loop and the whorl all with fewer than 4 ridges between the center of the figure and the nearest triradius have been counted as loops. This limit has been chosen on good empirical grounds. Between loop and arch the boundary line has been so taken that a pattern with one encircling ridge, lying unattached to the triradius, is counted as a loop.

I. BAKÓLA PYGMIES OF FRENCH EQUATORIAL AFRICA

In the southwestern part of French Equatorial Africa, there live groups of pygmies who are known as the Bakóla pygmies (not to be confused with the Bakoro, or Bakolo Negroes in the region of the Sanga River), also frequently termed Bagiella. Julien, in 1937, visited one northerly group and one southerly group (see fig. 3), the southerly group having been discovered by him. The material is of both groups, and concerns 233 individuals (130 males, 103 females). All the finger prints were clear enough for positive classifications.

The numbers respecting the incidence of the finger patterns, on the different fingers separately as well as on both hands, are given in table 4. The distribution of the patterns also among these Bakóla pygmies would appear to have the same peculiarities as have already been observed in all other peoples. Arches are most frequent on digits II and III and ulnar loops on V; radial loops especially on II; whorls, on the contrary, on I and IV, and in a less degree also on II. The right hand has fewer arches and more whorls than the left. The females present more arches and less whorls than the males. The arch/whorl index has its highest values on digit

TABLE 4

Bakóla Pygmies.

		MALES (n = 130)					FEMALES (n = 103)				
		Arches	Ulnar loops	Radial loops	Whorls	$\frac{\text{Arch}}{\text{Whorl}}$ — index	Arches	Ulnar loops	Radial loops	Whorls	$\frac{\text{Arch}}{\text{Whorl}}$ — index
Right hand											
Digit	I	4.6	29.2	0.8	65.4	7.0	5.8	29.1	2.9	62.1	9.3
	II	9.2	46.9	4.6	39.2	23.5	10.7	53.4	4.9	31.1	34.4
	III	9.2	70.0	1.5	19.2	47.9	12.6	65.0	0.0	22.3	56.5
	IV	3.1	55.4	0.0	41.5	7.5	4.9	60.2	0.0	35.0	14.0
	V	2.3	79.2	0.0	18.5	12.4	3.9	81.6	0.0	14.6	26.7
	Total	5.7	56.2	1.4	36.8	15.5	7.6	57.9	1.6	33.0	23.0
Left hand											
Digit	I	5.4	36.2	1.5	56.9	9.5	4.9	22.3	5.8	67.0	7.3
	II	12.3	46.2	6.2	35.4	34.8	13.6	41.7	10.7	34.0	40.0
	III	9.2	61.5	2.3	26.9	34.2	13.6	64.1	0.0	22.3	61.0
	IV	3.1	53.8	0.0	43.1	7.2	7.8	58.3	1.0	33.0	23.6
	V	2.3	79.2	0.8	17.7	13.0	4.9	76.7	0.0	18.4	26.6
	Total	6.5	55.4	2.2	36.0	18.1	8.9	52.6	3.5	35.0	25.4
Both hands		6.1	55.8	1.8	36.4	16.8	8.3	55.2	2.5	34.0	24.4

III, lowest on digit I. The right hand has a lower index than the left, and all indices in the females are higher than in males. None of these peculiarities differs in any single respect from what has in general been observed in the distribution of finger prints the world over (Dankmeijer, '34, '38).

The arch/whorl index, for all fingers together, amounted to 16.8 for the men, 24.4 for the women. Combining the sexes, we find for these 233 persons the following:

	Per cent
Arches	7.0
Ulnar loops	55.5
Radial loops	2.1
Whorls	35.3

Arch/whorl index: 19.8

Comparing the results obtained from the Bakóla pygmies with the aforesaid data of other African peoples, it is at once striking that the Bakóla pygmies are widely different from the Central African Efé pygmies who were characterized by a very high index (82.7, Dankmeijer; 100.6, Valšík). The difference is so manifest as to imply a very real distinction between the 2 pygmy tribes, who in this feature stand so widely apart. We shall return to this later, after presenting the results from other peoples examined.

II. BÁYAKA PYGMIES OF FRENCH EQUATORIAL AFRICA

The Báyaka pygmies are dwarfs who live in the vast region to the west of the Ubangui River, which includes, for instance, the basin of the Sanga River. They call themselves Báyaka; the contiguous Negroes usually name them Babenga, Babinga or Bebendzere. Julien visited these pygmies in 1938 and took finger prints of groups living east of the River Sanga, that is, between this river and the Ubangui (fig. 3), in all 203 men and 100 women. The prints were excellent and easy to study. In each of 4 cases the print of one finger was lacking, owing to the absence or mutilation of the digit in question.

Table 5 gives the distribution of the papillary patterns among these pygmies.

As regards the incidence on the different fingers and the difference between right and left hand, the same peculiarities are seen as a rule as among the Bakóla pygmies. Only the strikingly low percentage of arches on digits II and III in the women is noticeable, while the percentage of arches on digit I is the highest. This is in contradiction to what is observed everywhere else in the world, viz., that the arch pattern has a strong predilection for the forefinger and middle finger. This

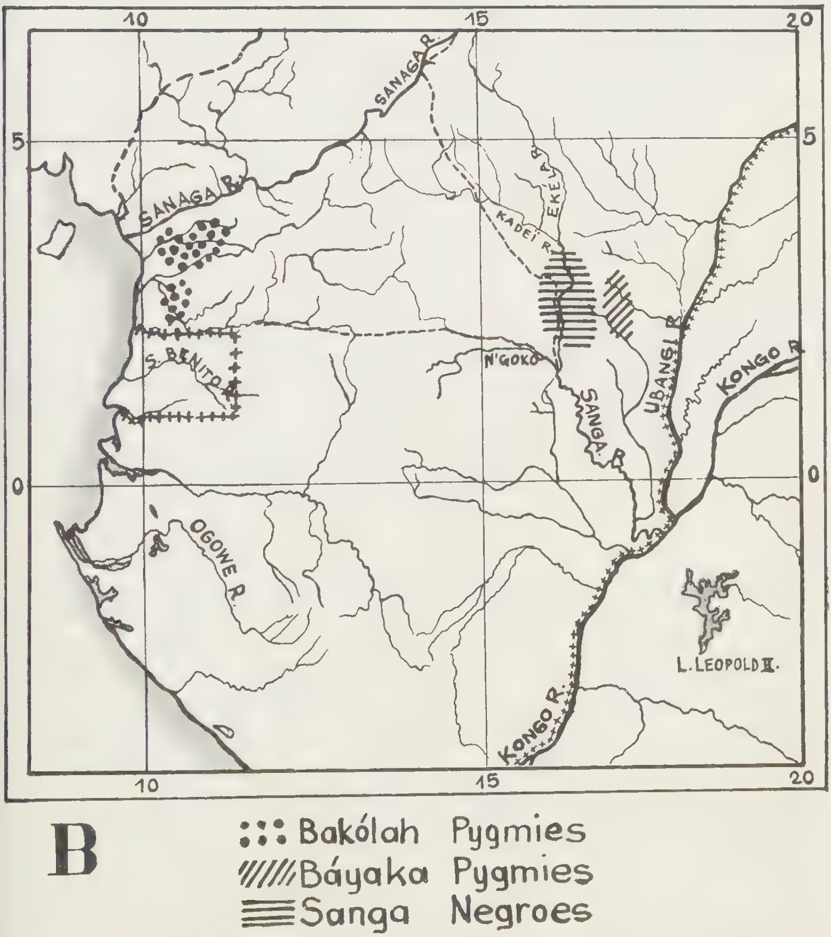

Fig. 3 Section B of figure 1 enlarged to show habitat of the Bakólah and Báyaka pygmies and the Sanga Negroes.

TABLE 5

Báyaka Pygmies.

		MALES	(n = 203)				FEMALES	(n = 100)		
	Arches	Ulnar loops	Radial loops	Whorls	Whorl / Arch — index	Arches	Ulnar loops	Radial loops	Whorls	Arch / Whorl — index
Right hand										
Digit I	5.0	30.2	2.0	62.9	8.0	6.0	22.0	1.0	71.0	8.5
II	7.9	30.2	16.8	45.0	17.6	2.0	40.0	7.0	51.0	3.9
III	10.3	57.1	1.0	36.9	27.9	4.0	64.0	0.0	32.0	12.5
IV	3.0	43.8	1.0	52.2	5.8	2.0	43.0	0.0	55.0	3.6
V	2.0	76.8	0.5	20.7	9.7	2.0	80.0	0.0	18.0	11.1
Total	5.6	46.6	4.2	43.5	12.9	3.2	49.8	1.6	45.4	7.1
Left hand										
Digit I	6.9	33.5	1.5	58.1	11.9	7.0	28.0	1.0	64.0	10.9
II	8.9	35.6	8.4	47.0	18.9	5.0	33.0	7.0	55.0	9.1
III	9.4	56.4	0.5	33.7	27.9	6.0	54.0	2.0	38.0	15.8
IV	3.4	49.8	1.0	45.8	7.4	3.0	48.0	1.0	48.0	6.3
V	2.5	84.7	0.5	12.3	20.3	2.0	89.0	0.0	9.0	22.2
Total	6.2	52.0	2.4	39.4	15.7	4.6	50.4	2.2	42.8	10.8
Both hands	5.9	49.3	3.3	41.5	14.3	3.9	50.1	1.9	44.1	8.8

difference in the incidence of the arch is largely the cause of the remarkable anomaly observable among this material of the Báyaka pygmies, namely, the fact that the women possess a lower index than the men. This result is so exceptional as to suggest that it may be ascribed to the small number of women (100) that were tested.[4] Only a further investigation that will furnish data of a greater number of Báyaka pygmies can answer the question as to whether in the incidence of the papillary patterns this pygmy group actually possesses such an anomalous sex difference.

The whole material, males and females together, 303 persons, yields the following:

	Per cent
Arches	5.3
Ulnar loops	49.6
Radial loops	2.8
Whorls	42.3

Arch/whorl index: 12.4

This result shows, as was the case with the Bakóla pygmies, a distinct difference with the values found among the Efé pygmies. But at the same time it indicates a real difference between the Báyaka and the Bakóla, although the difference between the 2 is considerably less than the difference between each of them and the Efé pygmies.

III. NEGROES FROM THE BASIN OF THE SANGA RIVER

Of the various Negro tribes who live round about the Sanga River, a tributary of the Congo, and who are also known by other names, such as Bakaro, Bakolo, Bayo, Bugongo, Bambouma, and others, Julien, in 1938, collected finger prints of 234 individuals. The place where the prints were made was a rather narrow strip on both sides of the middle reaches of the river (fig. 3). It must be noted particularly that the name "Sanga Negroes" here used for the collective tribes is by no means an indication of a homogeneous group. The grouping is to be regarded as merely geographical.

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[4] An indication of this may be the fact that on some fingers (viz. R I, R V, and L V) the females have a higher index than the males.

The material comprises finger prints of 115 men and 119 women. The prints of some fingers are lacking, but all are perfectly serviceable for classification purposes. The results of the examination, men and women again taken separately, are given in table 6. From these it will be seen that the incidence of the patterns on the different fingers does not differ in any particular from what has been observed elsewhere. Digit III has the highest index, and IV the lowest; the right hand has a lower index than the left. The sexual difference follows the general rule that females have a higher index than males.

The index of these Sanga Negroes is 26.7 for the men and 33.1 for the women, and is thus somewhat higher than of the Negro tribes discussed above; there is, however, a distinct similarity with my results in the Negroes of Sierra Leone (22.8 and 25.0 respectively). The similarity is greater in the case of the men than of the women; this enhances the value of the similarity, as the number of the men of Sierra Leone examined is materially larger than the number of women.

Combining the sexes, in the case of the Sanga Negroes, yields a valuable result because the number of men examined is practically equal to that of women. For the total of 234 individuals:

	Per cent
Arches	9.0
Ulnar loops	58.8
Radial loops	1.9
Whorls	30.2

Arch/whorl index: 29.8

IV. NEGROES FROM THE FRONTIERS OF FRENCH-GUINEA AND SÉNÉGAL

The last of the finger print collections placed by Julien at my disposal is of the Bassari and Coniagui, two Negro tribes which, together with the Badyaranké, belong to the so-called Tenda tribes. Both Bassari and Coniagui live in the frontier region between French Guinea and Sénégal, on the northern boundaries of the Fouta-Djallon mountain range, the Bassari

TABLE 6

Sanga Negroes.

		MALES (n = 115)					FEMALES (n = 119)				
		Arches	Ulnar loops	Radial loops	Whorls	$\frac{\text{Arch}}{\text{Whorl}}$ — index	Arches	Ulnar loops	Radial loops	Whorls	$\frac{\text{Arch}}{\text{Whorl}}$ — index
Right hand											
Digit	I	7.0	44.3	0.0	48.7	14.4	11.8	38.7	0.0	49.6	23.8
	II	12.2	41.7	9.6	36.5	33.4	14.3	48.7	4.2	32.8	43.6
	III	8.7	69.6	1.7	20.0	43.5	9.2	73.9	0.0	16.8	54.8
	IV	3.5	54.8	0.0	41.7	8.4	1.7	68.9	0.0	29.4	5.8
	V	5.2	80.9	0.9	13.0	40.0	4.2	83.2	0.0	12.6	33.3
	Total	7.3	58.3	2.4	32.0	22.8	8.2	62.7	0.8	28.2	29.1
Left hand											
Digit	I	13.9	40.0	0.9	45.2	30.8	13.4	33.6	0.8	52.1	25.7
	II	13.0	44.3	7.8	34.8	37.4	16.0	43.7	9.2	31.1	51.4
	III	12.2	61.7	1.7	24.3	50.2	15.1	68.1	0.0	16.8	89.9
	IV	3.5	59.1	0.0	37.4	9.4	6.7	58.8	1.7	32.8	20.4
	V	5.2	81.7	0.0	13.0	40.0	3.4	79.8	0.8	16.0	21.3
	Total	9.6	57.4	2.1	31.0	31.0	10.9	56.8	2.5	29.7	36.7
Both hands		8.4	57.8	2.3	31.5	26.7	9.6	59.7	1.7	29.0	33.1

in the hills, the Coniagui on the plains round Yukunkun (fig. 4). Most maps indicate that the Coniagui live most southerly, and the Bassari most northerly. According to Julien it is just the reverse, and the Bassari live to the south and south-east of the Coniagui. The Bassari are not to be confounded with the tribe of the same name from Togo.

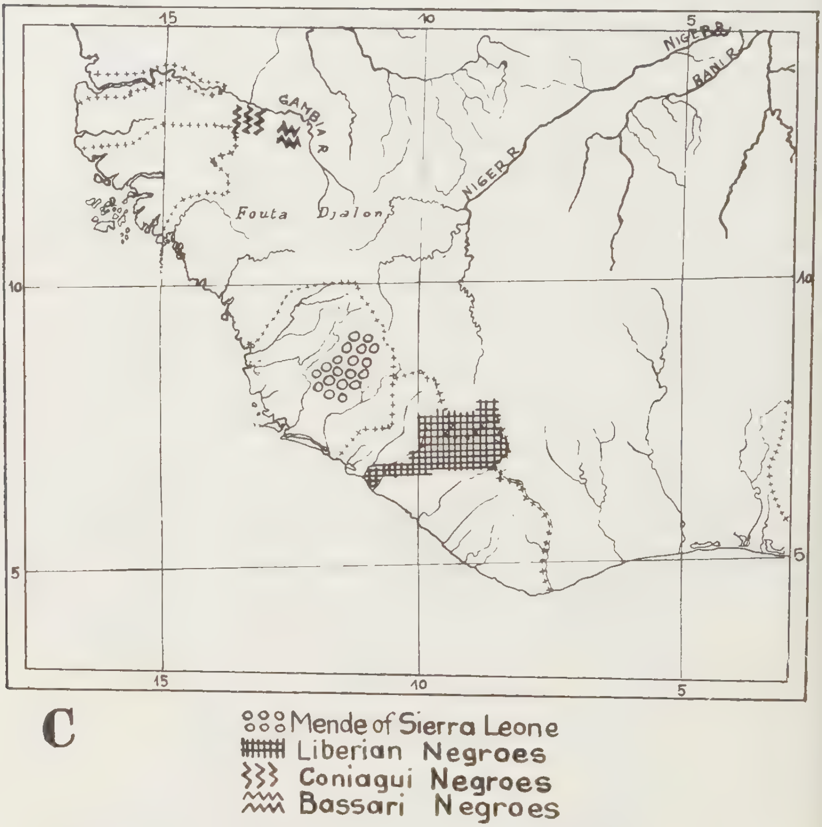

Fig. 4 Section C of figure 1 enlarged to show the habitat of the Mende of Sierra Leone and of the Liberian, Coniagui and Bassari Negroes.

Bassari. Finger prints of 198 persons, 141 men and 57 women were analyzed (table 7). The Bassari women show for most fingers a high percentage of arches and a low percentage of whorls, which results in extremely high indices. I ascribe

TABLE 7

Bassari Negroes.

	MALES (n = 141)					FEMALES (n = 57)				
	Arches	Ulnar loops	Radial loops	Whorls	$\frac{\text{Arch}}{\text{Whorl}}$ — index	Arches	Ulnar loops	Radial loops	Whorls	$\frac{\text{Arch}}{\text{Whorl}}$ — index
Right hand										
Digit I	7.1	54.6	3.5	34.8	20.4	12.3	47.4	1.8	38.6	31.9
II	4.3	56.0	13.5	26.2	16.4	19.3	57.9	5.3	17.5	110.3
III	5.7	81.6	0.0	12.8	44.5	19.3	75.4	0.0	5.3	364.2
IV	2.1	68.1	2.8	27.0	7.8	15.8	61.4	3.5	19.3	81.9
V	2.1	87.2	0.0	10.6	19.8	12.3	84.2	0.0	3.5	351.4
Total	4.3	69.5	4.0	22.3	19.3	15.8	65.3	2.1	16.8	94.0
Left hand										
Digit I	8.5	53.2	4.3	34.0	25.0	14.0	47.4	3.5	35.1	39.9
II	5.0	58.2	9.2	27.7	18.1	21.1	57.9	5.3	15.8	133.5
III	5.0	79.4	1.4	14.2	35.2	26.3	63.2	1.8	8.8	298.9
IV	2.1	80.1	0.0	17.7	11.9	12.3	75.4	0.0	12.3	100.0
V	2.1	90.8	0.7	6.4	32.8	14.0	86.0	0.0	0.0	. . .
Total	4.5	72.3	3.1	20.0	22.5	17.5	66.0	2.1	14.4	121.5
Both hands	4.4	70.9	3.5	21.1	20.9	16.7	65.6	2.1	15.6	107.1

these remarkable results to the small size of the sample and to fact that there were several individuals with a high frequency of arches, which raised the percentage of this pattern in the series as a whole. A comparison with the numbers in table 7, obtained from the far larger number of men, demonstrates clearly that the higher indices of the women must be regarded as accidental; a true sex difference as great as this has never yet been recorded.

For men and women together, 198 persons, the results are:

	Per cent
Arches	7.9
Ulnar loops	69.4
Radial loops	3.1
Whorls	19.5

Arch/whorl index: 40.5

This index, too, compared to the results from other Negro groups, may be termed a high one, again caused by the very high value in the women.

Coniagui. Of this group, the finger prints of 59 males and 60 females were at my disposal (table 8). These figures being derived from too small a number of persons, cannot be accorded a definitive significance. They are merely an approximation of the correct data. The indices, 21.9 and 42.6, men and women respectively, show great similarity with the values obtained from other Negro groups, although the sex disparity is greater than usual. The differential distribution of the patterns on the different fingers is characteristic and requires no special comment.

Taking the finger prints of the men and women of the Coniagui together, we arrive at the following percentages for the 119 persons:

	Per cent
Arches	8.2
Ulnar loops	62.2
Radial loops	3.3
Whorls	26.3

Arch/whorl index: 31.2

TABLE 8

Coniagui Negroes.

	MALES (n = 59)					FEMALES (n = 60)				
	Arches	Ulnar loops	Radial loops	Whorls	$\frac{\text{Arch}}{\text{Whorl}}$ — index	Arches	Ulnar loops	Radial loops	Whorls	$\frac{\text{Arch}}{\text{Whorl}}$ — index
Right hand										
Digit I	5.1	33.9	5.1	55.9	9.1	8.3	48.3	0.0	43.3	19.2
II	10.2	39.0	20.3	30.5	33.4	20.0	43.3	6.7	30.0	66.7
III	10.2	76.3	0.0	13.6	75.0	11.7	80.0	0.0	8.3	141.0
IV	0.0	62.7	1.7	35.6	0.0	3.3	71.7	0.0	25.0	13.2
V	0.0	89.8	0.0	10.2	0.0	1.7	93.3	0.0	5.0	34.0
Total	5.1	60.3	5.4	29.2	17.5	9.0	67.3	1.3	22.3	40.4
Left hand										
Digit I	8.5	40.7	5.1	45.8	18.6	11.7	35.0	5.0	48.3	24.2
II	15.3	40.7	8.5	35.6	43.0	15.0	41.7	11.7	31.7	47.3
III	11.9	69.5	0.0	18.6	64.0	16.7	71.7	1.7	10.0	167.0
IV	3.4	62.7	0.0	33.9	10.0	6.7	65.0	0.0	28.3	23.7
V	0.0	88.1	0.0	11.9	0.0	5.0	90.0	0.0	5.0	100.0
Total	7.8	60.3	2.7	29.2	26.7	11.0	60.7	3.7	24.7	44.5
Both hands	6.4	60.3	4.1	29.2	21.9	10.0	64.0	2.5	23.5	42.6

This index conforms closely to that of the Sanga Negroes (29.8); it is somewhat higher than that of the Negroes of Liberia and Sierra Leone (22.5, table 1) and lower than the value found of the Bassari (40.5).

Bassari and Coniagui. Whether there is any actual difference between the finger prints of the Bassari and Coniagui cannot be stated with certainty, considering the relatively small number of individuals examined. Remarkable, however, is the great conformity in the indices of the men. The 2 groups, on the grounds of other anthropological features, must be regarded as closely related. For this reason the percentages of the papillary patterns have been determined for the Bassari and Coniagui together, with the following result:

	MALES (200) *Per cent*	FEMALES (117) *Per cent*	ALL (317) *Per cent*
Arches	5.0	13.2	8.0
Ulnar loops	67.8	64.8	66.7
Radial loops	3.7	2.3	3.2
Whorls	23.5	19.7	22.1
Arch/whorl index:	21.3	67.0	36.2

This index is still somewhat higher than that of the Sanga, Liberia and Sierra Leone Negroes, yet it points in the same general direction as the indices of those Negro groups. The index of the Bassari and Coniagui males together (21.3) must be taken as the same as that of the Liberia and Sierra Leone Negroes together (19.1), whereas the male Sanga Negroes had an index of 26.7. If we compare these with the outcome of de Pina's research, which had bearing principally on the males, and in which an index of 19.2 can be computed, it will appear that whenever a sufficient number of males have been examined, a very great conformity exists between all the various Negro groups. The figures obtained from the females differ considerably more, which undoubtedly is due to the numbers examined being too small. The only group of Negroes of which finger prints of more than 100 women were available, were the Sanga Negroes; of the 119 women examined, an index of 33.1 was found, which is quite in accordance with the index of 26.7 for the men.

DISCUSSION

Reliable anthropological data respecting the African pygmies gathered from a sufficiently large number of individuals are still not available, notwithstanding the excellent work done by various researchers. Consequently, every contribution which furnishes new facts concerning this interesting group must be regarded as an asset. Added to this, all the competent researchers who have visited pygmies are of the opinion that they are losing their individuality owing to intermingling with the surrounding Negro tribes. For this reason there is a call for research to determine the physical peculiarities of the pygmies still living. This need is very urgent in dactyloscopy. With regard to the African Negroes it is largely the same situation. Of them, too, the dactyloscopic data are but scanty.

In spite of the incompleteness of the available data, it is nevertheless possible to ask whether our investigation throws light upon the problem of the African pygmies and their relation to the surrounding Negro tribes, as well as upon the distribution and affinity of the Negro groups.

Schebesta ('38) regards the pygmies living in the Ituri region as the purest. These tribes, to which he gives the common name of Ituri-Bambuti, comprise the Efé in the northeast portion, the Aka in the northwest portion, and the Basda in the southern part of the Ituri forest.

A second group, under the name of West-African Bambuti, comprising all the pygmies of West Africa, may be subdivided into 3 groups: The Bagenga (or Báyaka) pygmies to the west of the lower reaches of the Ubangui, the Bagiellito (or Baólo) in the coastal districts of Gaboun and the Cameroons, and the Bácwa pygmies in the region south of the great bend of the Congo. Somewhat inconsistently Schebesta terms the Babenga and the Bácwa Bambutoids, for they should have largely lost their purity of race. The Bagielli would then be the purest, and ought to have the name of Bambuti. As Schebesta writes ('38, p. 14): "Es unterliegt keinem Zweifel, dass sie rassisch und kulturell dem Grundstock der Ituri-Bambuti näher stehen als die Babinga und Bácwa . . ."

The third group of Schebesta is composed of the pygmies from the regions of the Kivu and Tanganyka Lake, known by the name of Batwa, who, by reason of their greater stature, among other traits, must be considered as pygmoids.

Finally, to the fourth group he assigns the East-African pygmoids who go by the name of Boni, considered to be very mixed survivors of an earlier widespread pygmy people. They now live on the Sabaki and Tana rivers.

Gusinde ('42) distinguishes 3 groups of pygmies, which agree with the first 3 groups of Schebesta, and all of which he entitles Bambutids. Gusinde writes ('42, pp. 406–407):

> "Wie ich berechtigerweise vermute, entstammen die drei Bambutidengruppen Afrikas einer und derselben Ausgangsform; bei ihrer Weiterentwicklung jedoch haben sich alle einer jeden dieser drei Gruppen eigentümlichen Rassenmerkmale ausgeprägt, wozu die Umwelt einen entscheidenden Beitrag geliefert hat."

If we now ask whether the dactyloscopic results set forth in this article can be of importance for an understanding of the distribution of the pygmy peoples, attention may be drawn first to an interesting peculiarity in the distribution of the papillary patterns. In reviewing what has become known on the subject of anthropological dactyloscopy, it becomes apparent that dactyloscopy admits a division of man into large groups. If we consider the arch/whorl indices, it will be seen that, for instance, all Mongolian peoples have a very low index (< 10), the North European peoples an index which lies between 25 and 40, the South Europeans an index between 10 and 20. (For women the index is usually about 10 to 15% higher than for men.) Within these groups there may be small but real differences between sub-groups, but it has never yet been observed that any people had an index that fell quite outside the index proper to the stock to which it belongs. According to our present-day knowledge we may thus conclude that 2 groups which have widely different indices do not belong to one and the same principal races. We are, however, not entitled to draw a similar conclusion in the contrary case, namely that groups of persons having very similar indices belong to the same race, because of the fact that not all human groups have been examined, and it is possible, as is the case with other anthropological characteristics, that groups otherwise quite dissimilar may agree in one single characteristic, such as the arch/whorl index.

We are struck by the position of the Efé pygmies. They are distinguished by a very high arch/whorl index, as shown both in the writer's own results and in the figures computed by Valšík from Schebesta's material. This index puts the Efé in a place apart from all other peoples or races thus far examined. We must therefore conclude that this group of pygmies, which is generally regarded as the purest, represents a group entirely apart from any other. In particular it is distinguished clearly in dactyloscopic respect from the Negroes, which is a strong argument against the old opinion of Schwalbe ('05), now combatted by many researchers on other grounds, that the pygmies are merely locally degenerated varieties, and that the degeneration has been caused by unfavorable circumstances.

Although the Efé pygmies occupy a distinctive place in the list of the dactyloscopic results known to the present, the possible similarity of the Bushmen should be noted. However, the series of Bushmen examined by M. Weninger was too limited (32 persons) for any reliable results, so that we will merely draw attention to the fact, at the same time pointing out the desirability of more extensive research into the finger prints of the Bushmen. But we may quote here the opinion of Schebesta ('38) who, on the grounds of a comparison of other physical features of the Bambuti and the Bushmen, writes (p. 381):

> "Die aus dem Vergleich der Bambutti und Buschmänner sich ergebende zwingende Folgerung ist die, dass in den Buschmännern eine grössere Anzahl wesentlicher Pygmäenmarkmale steckt."

Entirely different is the position of the Hottentots. The values found by Fleischhacker ('34), in his comparatively scanty material of 50 individuals from which an index of 27.4 is to be computed, indicates a probable affinity with the African Negroes and distinguishes the Hottentots clearly from the Bambuti group of the Efé pygmies and from the Bushmen.

In an earlier publication (Dankmeijer, '38), the writer treated the question as to what significance must be accorded in comparative anatomical and phylogenetical respects to the very high index of the Efé pygmies, and in the same place criticised the idea commonly accepted in the literature that the incidence of whorls on the fingers of man is a primitive characteristic. There is, however, no decisive answer as yet to this question, in the first place because there is so little certainty concerning the significance of the arch pattern, but more especially because too little is yet known respecting the rest of the dermatoglyphics of these little people.

Entirely different from the figures for the Efé pygmies are those for the Bakóla and Báyaka pygmies. The indices of these groups (Bakóla, males, 16.8, females, 24.4; Báyaka, males 14.3, females, 8.8) are so widely at variance with those of the Efé (males, 81.1, females, 86.7) that on the grounds of this dactyloscopic character alone we should have to deduce a great racial difference. This is not in accordance with the opinions in the literature; as was explained above, it is generally held that the 3 groups studied belong to one and the same pygmy race (Gusinde, '42). Schebesta ('38) even characterizes the Bakóla (Bagielli) as Bambuti, thus placing them directly after the Efé group, whereas he considers the Báyaka (Babenga) as Bambutoids. However, for the Efé pygmies, data of a large number of definite physical characteristics are recorded in the literature (e.g. the work of Schebesta above cited), but of the Bakóla and Báyaka no detailed physico-anthropological researches are known to me. We cannot draw far-reaching conclusions solely upon the outcome of the dactyloscopic research. It is remarkable that both the Bakóla and the Báyaka differ so widely from the Efé pygmies. The index for the Bakóla, however, is higher than that for the Báyaka, so that the former stand somewhat closer to the Efé. This is in accordance with Schebesta's conception mentioned above. Further it must be noted that both groups in their dactyloscopic characters stand fairly close to the Negro groups. And yet they cannot certainly be assigned to the Negroid race; they belong, like true pygmies, to the little peoples. Thus, on the grounds of the dactyloscopic investigation, one might assume the existence of separate African pygmy divisions, one with a high arch/whorl index to which the Efé group, and probably the Bushmen, belong, and a second with a low dactyloscopic index, including the Bakóla and Báyaka. Further research among these last groups, as regards their other physical characteristics is essential before we can arrive at any decisive conclusion. Of like importance would be an investigation as to the papillary patterns of the no less interesting Asiatic pygmies, as are met with in Malacca, the Philippines and New Guinea. Up to the present, however, no dactyloscopic data are known.

The Negro groups examined exhibit an entirely different aspect from that of the pygmies. In the first place, there is a striking similarity of the figures which have been determined for Negro tribes living at great distances from each other. This can be best shown by comparing my results with the figures found in literature. As most of the investigations made by other authors report on the finger prints of males and in my materials the number of males is larger than that of the females, it is interesting to compare the indices of all these Negro men. Taking the 2 groups of Angola Negroes of Sarmento's paper together, we get the following data:

	SUBJECTS	ARCH/WHORL INDEX	AUTHOR
Liberia and Sierra Leone	58	9.3	Cummins, '30
Liberia	89	11.3	Dankmeijer, '38
Libya	250	16.0	Falco, '17–'18
Angola	220	18.0	Sarmento, '39
Portuguese Africa	275	19.2	de Pina, '36
Central Africa	25	19.4	Valšík, '38
Bassari	141	20.9	Present study
Coniagui	59	21.9	Present study
Sierra Leone	149	22.8	Dankmeijer, '38
Sanga	115	26.7	Present study

With the exception of Cummins' material and of my material of Liberian Negroes, both of rather few individuals, all the indices of the males lie between 16.0 and 26.7. All these results point clearly to an affinity between the different Negro groups, and would almost lead us to infer a general index for the African Negroes. It will be advisable, however, to reserve such a conclusion until confirmed by an examination of more groups of the widely dispersed Negroid race.

For the present, however, the dactyloscopic investigation among the pygmies and Negroes points in another direction than that usually followed. Gusinde, as we have seen (p. 478), holds that the pygmies are a biological unit somewhat distinct from the Negroes. The examination of the papillary patterns, on the contrary, points to the existence of 2 pygmy groups, and to an affinity between the various scattered Negro groups. Only further and exhaustive research will be able to show which of these views is correct.

SUMMARY

The results are given of an investigation of new finger print material from Africa, collected by Julien. It comprises the finger prints of 233 Bakóla pygmies (coastal districts of the French Cameroons), 303 Báyaka pygmies (frontier region of the Cameroons and the Belgian Congo), 234 Sanga Negroes (basin of the River Sanga) and 317 Bassari and Coniagui Negroes (frontier region between Guinea and Sénégal). These results are compared with the data of the finger prints of the Efé pygmies and Liberian and Sierra Leone Negroes, also collected by Julien and already published by the author, and with the data from the literature. The arch/whorl indices of the 4 new groups (males and females taken together) are respectively: Bakóla, 19.8, Báyaka, 12.4, Sanga, 29.8, and Coniagui and Bassari, 36.2. The figures, obtained from the newly investigated pygmy tribes, differ distinctly from the values found among the Efé pygmies (82.7), whereas the values of the Negroes are in accordance with most results obtained by other investigators. Regarding the dactyloscopic results, the

author suggests the existence of at least 2 divisions among the African pygmies; the figures for the dispersed Negro tribes show a great resemblance and indicate a strong affinity among the groups of the great Negroid stock. These conclusions point in another direction than that usually followed.

An appeal is made for further investigation of the highly interesting peoples of Africa, of which some of the anthropologically most important ones are rapidly dying out.

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——— 1937 Fingerabdrücke von zentralafricanischen Batwa-Pygmoiden des Kivu-Gebietes. Mitt. Anthrop. Ges. Wien, *67:* 162–168.

DOMINANCE IN BLOOD GROUP SYSTEM.— In general, nearly every blood group gene has been found to give rise to a corresponding antigen, and this is always detectable whether present in double or single dose in the genotype. Within each blood group system a linear series of antigenic characters can be established, of which each member shows a slight degree of dominance to the next. The evidence is, however, of a very patchy nature, and the subject is one which deserves, and is indeed receiving, much further investigation.— A. E. Mourant, Dominance and recessiveness in the human blood groups. Nature, vol. 160, no. 4063, Sept. 13, 1947, pp. 353–355.

COMPARATIVE RATES OF VISUAL LEARNING.— The prompt visual learning so characteristic of the normal adult primate is . . . not an innate capacity, independent of visual experience, but requires a long apprenticeship in the use of the eyes. At lower phylogenetic levels the period of apprenticeship is much shorter. The chick makes effective use of vision immediately upon hatching and shows further improvement of efficiency with the practice afforded by a dozen pecks. Rats reared in darkness, when first exposed to light, show no clear utilization of vision but learn to jump in response to visual cues within 15 minutes and after an hour or 2 may be indistinguishable from the normally reared animal. The chimpanzees of the present study received 50 hours of exposure before the first visually mediated learning was evident; and man, to judge by some of Senden's cases, may require an even longer exposure.— Austin H. Riesen. The development of visual perception in man and chimpanzee. Science, vol. 106, 1947, pp. 107–108.

INCIDENCE OF SINGLE AND MULTIPLE RENAL ARTERIES IN NEGROES

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The stimulus for the present investigation was the finding of occasional polar arteries in a series of 54 arterial corrosion preparations of the human kidney (Ronstrom, '38). It was then decided to record the ocurrence of such branches in a larger series, as observed in supervised dissection, and to confine the observations to Negroes.

In 1889–1890 the Anatomical Society of Great Britain and Ireland conducted a survey of variations of blood supply to the human kidney. Thomson (1891) correlated the findings on 419 specimens. Eisendrath and Strauss ('10) dissected the arterial blood supply in 200 human kidneys. Their excellent paper also gives a report of earlier work. Gerard ('11) studied 150 bodies with particular emphasis on the anterior and posterior first branches of the renal artery. Ruppert ('13) studied 100 kidneys for vascular irregularities. Eisendrath ('20) studied arterial variations in 218 kidneys. Adachi ('28) published a report on 338 kidneys studied in the Japanese. Lloyd ('35) published results of 144 kidneys in Whites and 162 in Negroes. Anson and co-workers ('36) reported on variations in number and arrangement of renal vessels. Weinstein and co-workers ('40) studied kidney vessels in 203 cadavers (predominantly Negro). The results of these investigators, insofar as they can be reduced to camparable terms, are summarized in table 1.

Aside from Lloyd's 1935 report on 162 Negro kidneys, other and more numerous figures were exclusively on Whites. Before it can be determined if racial characteristics appear in renal vasculature, a comparable number of Negro kidneys must be studied.

Little attention is called to irregular polar arteries in anatomy textbooks. Arey, in his book "Developmental Anatomy," 5th Edition, speaks of the non-segmentally arranged lateral branches of the descending aorta. He says: "The original number is reduced, and from them emerge the renal, suprarenal, inferior phrenic, internal spermatic, or ovarian arteries." Renal polar or aortic polar arteries are not listed. Bremer ('15) studied the embryonic blood supply of kidneys and related organs and found mechanical factors to be the determining agents of the final vascular pattern. Multiple renal arteries represent persistent horizontal channels from the aorta and early vascular mesonephric network.

METHODS AND MATERIAL

The dissections and studies were all made in the dissecting laboratory of the Louisiana State University College of Medicine. The bodies were those provided for the students and came from different parts of the state. All the subjects were thoroughly embalmed, some with glycerin-phenol-alcohol solution, others with formalin. One hundred Negro bodies were used, 92 males and 8 females, giving a total of 200 kidneys.

Careful dissections were made so as to leave the kidneys and renal arteries in place. The veins in their anterior plane relationship were removed so as to see more readily the renal arterial blood supply at the hilum, and particularly to study it at the superior and inferior poles. It was felt that no unusual branches escaped attention.

OBSERVATIONS

The present data are added to those of the workers cited in table 1. It appears that most of the work has been done on Whites, 1081 kidneys by count. For racial comparison there are specifically only 362 Negro kidneys. In table 1 they are tabulated in the series of Lloyd and the present author and show marked agreement. Weinstein et al. ('40) studied a large series of kidneys but did not tabulate results separately for Negroes and Whites. Anson's ('36) series could not be reduced to comparable terms for inclusion in table 1.

Textbook illustrations, e.g., Senior ('33), show the renal artery arising from the aorta and coursing laterally to enter the kidney substance through the renal sinus. The renal veins, predominantly anterior, are peripherally related to the renal artery. As described, the arterial supply enters the kidney midway along its medial concave border. This is the most frequent arrangement. However, 5 less common patterns of additional arterial supply to the kidney have been observed and tabulated.

TABLE 1

Frequency of renal polar arteries.

AUTHOR	TOTAL KIDNEYS	RACE	NORMAL	SUPERIOR AORTIC POLAR	SUPERIOR RENAL POLAR	INFERIOR RENAL POLAR	INFERIOR AORTIC POLAR
Thomson (1891)	419	White	312 74.4%	29 6.9%			17 4.0%
Ruppert ('13)	100	White	73 73.0%	17 17.0%			8 8.0%
Eisendrath and Strauss ('10)	200	White	168 87.6%	5 2.5%	19 9.5%		7 3.0%
Eisendrath ('20)	218	White	123 54.6%	13 5.9%	49 22.2%	1 2.0%	31 13.0%
Lloyd ('35)	144	White	85 59.7%	15 10.4%	26 18.0%	1 0.7%	10 7.0%
Ronstrom (present)	200	Negro	134 67.0%	18 9.0%	24 12.0%	6 3.0%	8 4.0%
Lloyd ('35)	162	Negro	112 69.0%	17 10.4%	19 11.7%	2 1.2%	5 3.0%

Superior aortic polar arteries were found originating from the abdominal aorta above the renal artery and terminating in the kidney above the hilum. Multiple renal arteries were seen taking origin from the abdominal aorta and entering the hilum in relation to the pelvis and renal veins. Superior renal polar arteries were discovered arising from the renal artery and supplying the kidney superior to the hilum.

Superior aortic polar arteries were noted in 9% of the kidneys: 10 on the right side and 8 on the left. Those on the right side ran posterior to the inferior vena cava. They all originated about 1 inch above the homolateral renal artery.

In 5% of the specimens examined, multiple renal arteries were found entering the renal sinus. The number was always 2 in the 10 kidneys showing this variation, and all came off the abdominal aorta, 3 on the right side and 7 on the left.

The most common variation was the superior renal polar artery, found in 12% of kidneys. Such branches all came off the renal artery close to the origin of the renal artery itself from the abdominal aorta. Twelve were found on the left and 12 on the right side.

TABLE 2

Incience of single and multiple renal arteries in American Negroes.

NUMBER OF KIDNEYS	NORMAL	SUPERIOR AORTIC POLAR	MULTIPLE RENAL ARTERIES	SUPERIOR RENAL POLAR	INFERIOR RENAL POLAR	INFERIOR AORTIC POLAR
200	134	18	10	24	6	8
	67.0%	9.0%	5.0%	12.0%	3.0%	4.0%

Of the 134 normal single renal arteries encountered, 61 were in left kidneys and 73 in right kidneys. Twenty-eight cadavers had normal single renal arteries on both sides. Inferior renal polar arteries occurred in 6 kidneys, 4 on the left and 2 on the right. They were only 3% of the total number. Inferior renal polar arteries were noted branching off the renal artery and entering the kidney substance below the hilum. Inferior aortic polar arteries came off the abdominal aorta and terminated in the kidney below the hilum in 8 instances. Five were on the left and 3 on the right side. No polar vessels were encountered originating otherwise than from the renal artery and abdominal aorta. Five per cent (10 kidneys) showed multiple renal arteries entering the renal sinus.

In table 2 are listed the different patterns of renal arterial blood supply and the total number of kidneys studied by the author. Shown also are the percentages of the total showing each pattern of supply.

Inferior aortic polar arteries were found in 4% of the kidneys studied. In contrast to the superior aortic polar vessels, they took origin at a greater distance away from the renal artery (2 inches) and were at least twice as large in caliber. Two were on the right side and 6 on the left.

CONCLUSION

Two hundred kidneys from 100 Negro cadavers were studied from a standpoint of gross normal blood supply. Sixty-seven per cent presented the single renal artery not supplemented by any polar vessel. They originated from the abdominal aorta and coursed laterally to enter the renal sinus on the medial concave kidney border. Five per cent showed double renal arteries, same course and relations described above, also unaccompanied by polar vessels. Nine per cent showed superior aortic polar arteries supplying the kidney in addition to typical renal arteries. Twelve per cent showed superior renal polar arteries bringing blood to the kidney in addition to the renal artery proper. Three per cent had inferior renal polar arteries in addition to normal renal arteries. Four per cent had aortic polar arteries along with proper renal arteries.

There is marked agreement in percentage frequencies of renal vessels in the Negro. Relatively quite larger degrees of difference are found both in comparing the same frequencies of Whites among themselves as well as to the Negroes.

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VIKING PRIZE AND MEDAL FOR 1947. A committee to select a candidate for the Annual Viking Prize and Medal in the field of physical anthropology has been appointed by Dr. W. M. Krogman, President of the American Association of Physical Anthropologists. This committee consists of the officers of the Association (Carleton S. Coon, C. Wesley Dupertuis, W. M. Krogman, Gabriel Lasker, Theodore D. McCown, Morris Steggerda) and five members-at-large (Joseph B. Birdsell, Loren C. Eiseley, W. W. Howells, H. L. Shapiro, T. D. Stewart). The award will be made at the annual meeting of the Association in April.

ANTHROPOLOGY OF CENTRAL SWEDEN.— During the years 1931–1943 the author made anthropological investigations in Central Sweden. Measurements and observations taken by the author have been recorded for 15,000 persons, about 59% of whom are males. Above all I have concentrated on the famous, old province of Dalarna (Dalecarlia), where I visited practically all the large villages. In other provinces, such as Helsingland, Central Uppland and Northern Vermland my investigations have been more superficial.

I examined only adult men and women of local ancestry and recorded stature, head length, head breadth, biygomatic breadth, face height, nasal form, hair color, eye color. *Local* investigations of any value have not been performed by researchers in those districts.— Bertil Lundman. Dala-Allmogens Antropologi (Thesis), Uppsala, 1945, 208 pp.

OBSERVATIONS ON THE PARTICIPATION OF ARIZONA'S RACIAL AND CULTURAL GROUPS IN WORLD WAR II

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The second installment of World Wars was 2 years underway when the writer undertook to record some observations on men from Arizona's racial and cultural groups passing through the Army Induction Station serving the State. The bits of information presented here were gathered as a spare time activity without the cooperation of the military, or even their sanction. Unfortunately, it seems the military is selfishly willing to use the information gleaned by social scientists but they are unwilling to assist or even participate in its collection. To obtain anthropometric data, of course, was impossible under these circumstances.

A four-fold classification is used in this report, White, Negro, Mexican and Indian. ''Mexican'' is used because in Arizona the people of this national origin represent a distinct and numerous cultural entity; and ''Indian'' because these aborigines are almost the sole representatives of the Mongoloid race in the State. It is to be regretted that the very nature of the source of this information precluded a comparative study of the various Indian tribes. Rejections and acceptances of representatives from a random sample of these 4 groups are listed in table 1.

There are also Chinese and Filipinos, as well as other peoples, represented in Arizona, but these constituted less than 1% of the total number of men reporting for induction. Approximately half of these were rejected. For the entire nation rejections for the period of 29 months ending December, 1943, amounted to 38.3% of all the Whites and 57.7% of the Negroes appearing for induction (Greve et al., '44, p. 116–117).[2]

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[1] Formerly Assistant Induction and Recruiting Officer for the State of Arizona, U. S. Army.

TABLE 1

Acceptances and rejections by group in a sample of 3133 Arizona men from the period up to December 1, 1943.[1]

	WHITE	MEXICAN	INDIAN	NEGRO
Number of sample	1842	853	278	149
Percent of men reporting	59	27	8	5
Percent accepted	73	65	55	54
Percent rejected	27	35	45	46

[1] As of this date approximately 53,000 men had passed through the Induction Station in Phoenix, Arizona. The sample also included 6 Chinese and 5 Filipinos.

The frequencies of occurrence of the principal reasons for rejections in Arizona are indicated in table 2, along with comparative figures for the nation as a whole but only for the latter months of the whole period. The Selective Service, incidently, used a twofold racial classification, Negro and White. Indians, Chinese, and all other racial and national groups not definitely Negro were classed as Whites. In table 2, therefore, in the Negro and White columns, where national figures are included in parentheses, appropriate consideration of this fact should be allowed in making any comparisons.

The prevalence of trachoma among the Indian population of the State is readily apparent. The 11% rejected for this affliction gives some indication of its seriousness among the Indian population. However, it was obvious to those along the induction line that trachoma existed primarily among the Navaho. This tendency, plus the fact that they outnumbered all other Indians in actual numbers, makes the Navaho largely responsible for the high figure of 11%. Indian Service data ought to be more illuminating in this matter.

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[2] These percentages are arithmetic means computed from the figures for individual months.

It is probable, too, that Indians from boards other than those serving the Navaho were eliminated, if afflicted, before they were sent to the Induction Station. There was little effort on the part of the Selective Service Boards serving the

TABLE 2

Causes of rejections by group in a sample of 4000 Arizona men. (1000 of each group).

	NEGRO		INDIAN	MEXICAN	WHITE	
	%		%	%	%	
Eyes	3.0	(4.0)[1]	3.7	5.8	3.1	(7.6)
Trachoma	..		11.0	.4	.4	
Ear, nose and throat	3.2		11.2	12.3	6.7	
Teeth	.4	(.4)	..	..	..	(1.8)
Varicose veins	..	(.7)	..	.1	.4	(1.1)
Hemorrhoids	..	(.4)	..	.3	.7	(.4)
Hernia	3.2	(2.7)	.6	5.7	5.0	(4.8)
Genito-urinary tract	1.1		1.1	2.0	1.0	
Syphilis	9.1	(3.8)	.6	3.3	4.7	(1.2)
Gonorrhea	5.5	(1.1)	..	..	..	(.1)
Feet	1.6	(3.8)	..	1.0	.9	(2.5)
Musculo-skeletal	3.8	(4.8)	4.0	9.8	9.4	(8.0)
Abdominal viscera	..	(.5)	..	1.5	.5	(1.9)
Gastro-intestinal	.1		..	.4	1.0	
Cardiovascular	9.5	(7.5)	3.1	3.5	3.7	(7.3)
Hypertension	..		.4	2.5	3.0	
Pulmonary	5.2		6.1	7.0	19.2	
Respiratory	17.2		1.6	3.0	6.2	
Endocrine system	..	(.2)	.7	.3	.7	(1.0)
Diabetes	..		..	.1	.7	
Neurological	1.0	(3.7)	..	.2	.1	(4.3)
Mental	4.7		2.0	3.0	11.9	
Epilepsy	..		..	.3	1.1	
Alcoholism	..		..	.3	.9	
Underweight	2.5		3.1	18.3	4.2	
Administrative	2.6		1.7	2.3	1.9	
Educational	23.5	(29.5)	48.5	15.0	12.1	(7.3)
Miscellaneous	2.8		.6	1.6	.5	
Totals	100.0		100.0	100.0	100.0	

[1] Figures in parentheses (Greve et al., '44, p. 119) represent national percentages for the period April–December, 1943, and are included for comparative purposes. Since only 5% of the Arizona men reporting for induction were Negro and 8% Indians, the figures for these 2 groups have a higher degree of accuracy than those for the Whites.

Navaho to "screen out" Indians with trachoma (or other communicable diseases for that matter) before they were sent to the Induction Station serving Arizona. This was purely a practical matter and they considered themselves fortunate in the herculean task of collecting the men from their isolated camps and sending them to the Induction Station, let alone give them a cursory physical examination. Indeed, one Selective Service Board member, serving the Navaho, who was also an Indian Service employee, remarked that many of these Indians were sent to the Induction Station for the primary purpose of giving them a view, often a first view, of a large city built by white men, believing that the experience would favorably impress them with the superiority of European culture.

Returning to the ailments of Arizona's manhood, Mexicans and Indians alike suffered with ear afflictions, particularly otitis media, and perforated ear drums. Likewise, both of these groups exhibited the poorest eyesight. It was noted, too, that a large number of the men who possessed very poor vision also recorded low scores on their educational tests.

Negroes ranked high in venereal diseases, in respiratory ailments, and foot troubles. They also ranked high in rejections for administrative reasons, such as arrests for theft, and other criminal offenses. On the other hand, Negroes were seldom rejected for having poor eyesight, diabetes, varicose veins or hemorrhoids, or psychoneuroses.

Not noted in table 2 was the high percentage of bronchitis among the Whites, and its rarity among the other groups. Psychoneuroses were common among both Whites and Mexicans, although the Induction Station psychiatrist admitted he had no objective measure of its presence among the less acculturated Indians, particularly the Navaho. Epilepsy and chronic alcoholism, likewise, appeared mainly among Whites and Mexicans.

Over 18% of the Mexicans were rejected because they were underweight, a percentage materially above that of any of the other 3 groups. These Mexicans, suggested the Induction

Station medical officers, were underweight not necessarily because of glandular or dietary deficiencies, but because the Army's standards were high.[3] In other words, due allowance was not made for the less rugged and finer bony structure of these men who were otherwise in good physical condition.

The chief cause of rejection among all 4 groups was the lack of education and poor mental endowments, as recorded in the various Army tests. Nearly half of the Indians failed to pass the Army's psychology tests, and one-fourth of the Negroes were unacceptable for this same reason.

In the matter of education among the Indians, the Navaho presented special problems to the Induction Officers. The Indian Service had managed to teach English to most of the other natives of the State, but the isolation and mode of living followed by the Navaho had made this accomplishment among them much more difficult. Consequently, they presented the poorest impression to those responsible for the induction of manpower into the services.

Needless to say, the Indians, as well as Mexicans, Whites and Negroes often malingered in an effort to create an impression of undesirability in hopes of being rejected. It was fairly common for some Navaho men to wander carelessly about Phoenix, "lost," and unmindful of any schedule they had to meet at the Induction Station. Except for a few obvious cases, malingering among the Navaho was particularly difficult to detect.

The American Indians and Mexicans constitute important minorities in many of the states where they now live, but unfortunately they are seldom analyzed as separate entities in official demographic publications. It is for the purpose of supplying such a record, even though fragmentary, for one of these states that the foregoing data are presented.

[3] Dr. C. S. Coon, of Harvard University, states in a personal communication that the French made a similar "mistake" about 50 years ago when they began to conscript Senegalese. "They rejected most of the Fula, a warlike race who have been fighting men for centuries, because they were too skinny and underweight, and took the servile tribes who had not been good fighters at all."

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Progenitor of the African Bushman.— The writer claims that he is in a more favorable position to evaluate the status of the Florisbad skull than are overseas anthropologists. The latter have available only 2 types for comparison: Neanderthal and *H. sapiens*. It is true that a number of South African skulls are also at their disposal; but no one with the full knowledge of the facts and of a duly critical turn of mind would venture to deny that the study of early man in South Africa has been rather unfortunate in its beginning. The writer however has been extremely lucky in his excavations of the Matjes River Rock Shelter. Here he found an apparently uninterrupted sequence of occupations from the beginning of the Mossel Bay Culture up to the historical period, and right at the base of this deposit a skull M.R.I. which yields most valuable evidence re the Florisbad question.

This skull was amongst those M.R. skulls submitted to and described by Sir A. Keith.

Keith, knowing the curious and often disharmoniously developed skulls which have gained such undue attention, not appreciating the age of the specimen (the writer claims that for properly dated skulls the M.R. I is the second most ancient, the Florisbad being the oldest, yet discovered in South Africa), and not probably having seen the variety and numbers of Bushman skulls that the writer has — for all these reasons did not show particular interest in the M.R. I skull and mentions only . . . its pronounced trigonocephaly . . .

The result [of superimposing the Florisbad contour on that of the M.R.I skull] is rather surprising. The original reconstruction had porion in exactly the new position found for it; it was only a few mm lower than in its new position. However, the ventral portion of the occipital profile becomes more bun-shaped in cross-section than in my first reconstruction.

The Florisbad skull thus fits almost ideally as the progenitor of the M.R.I, Bushman series.— T. F. Dreyer. Further observations on the Florisbad skull. Soöl. Nav. Nas. Mus., Bloemfontein, De. 1, St. 15, 1947, pp. 183–190.

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